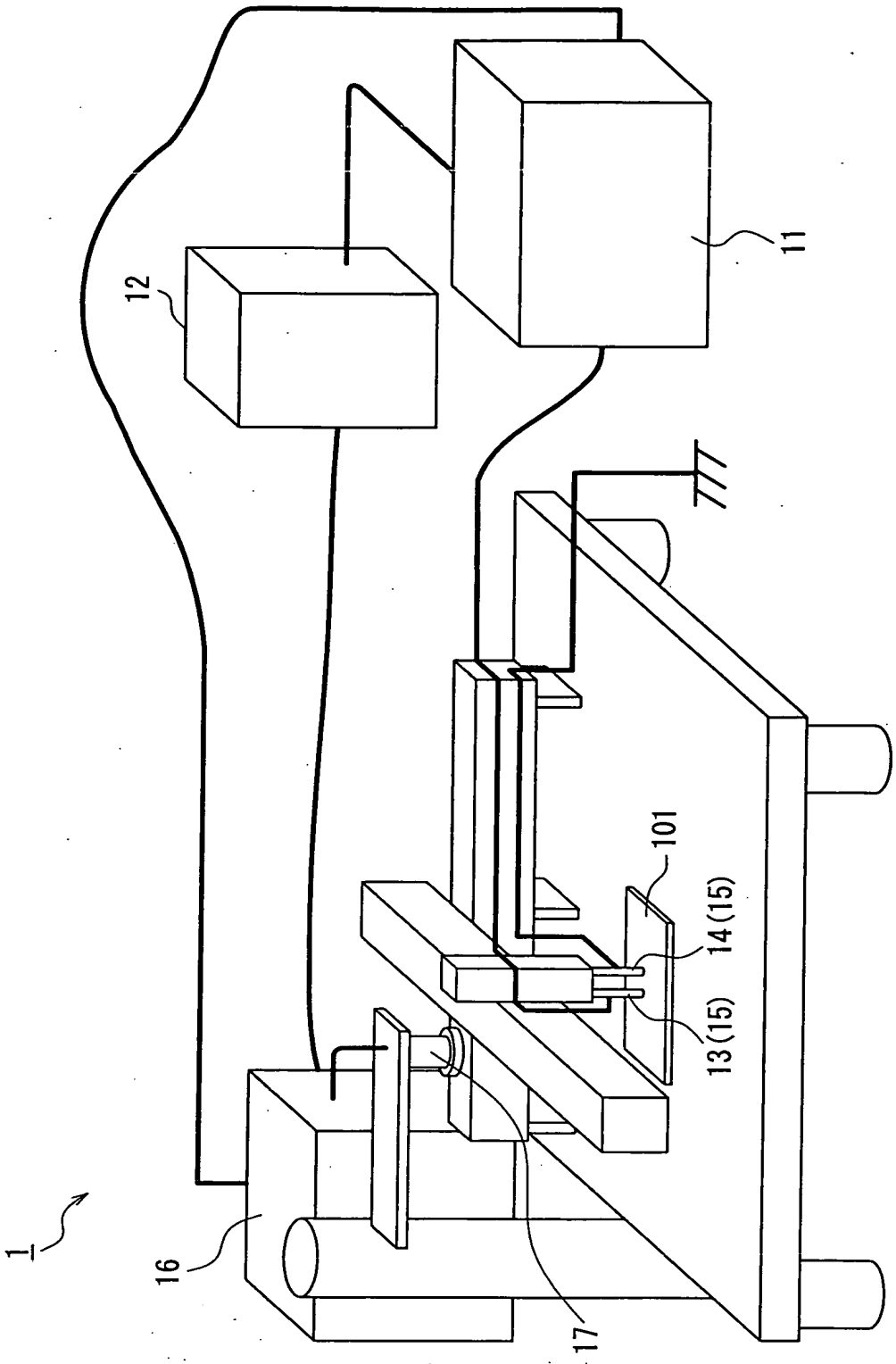


FIG. 1

BEST AVAILABLE COPY

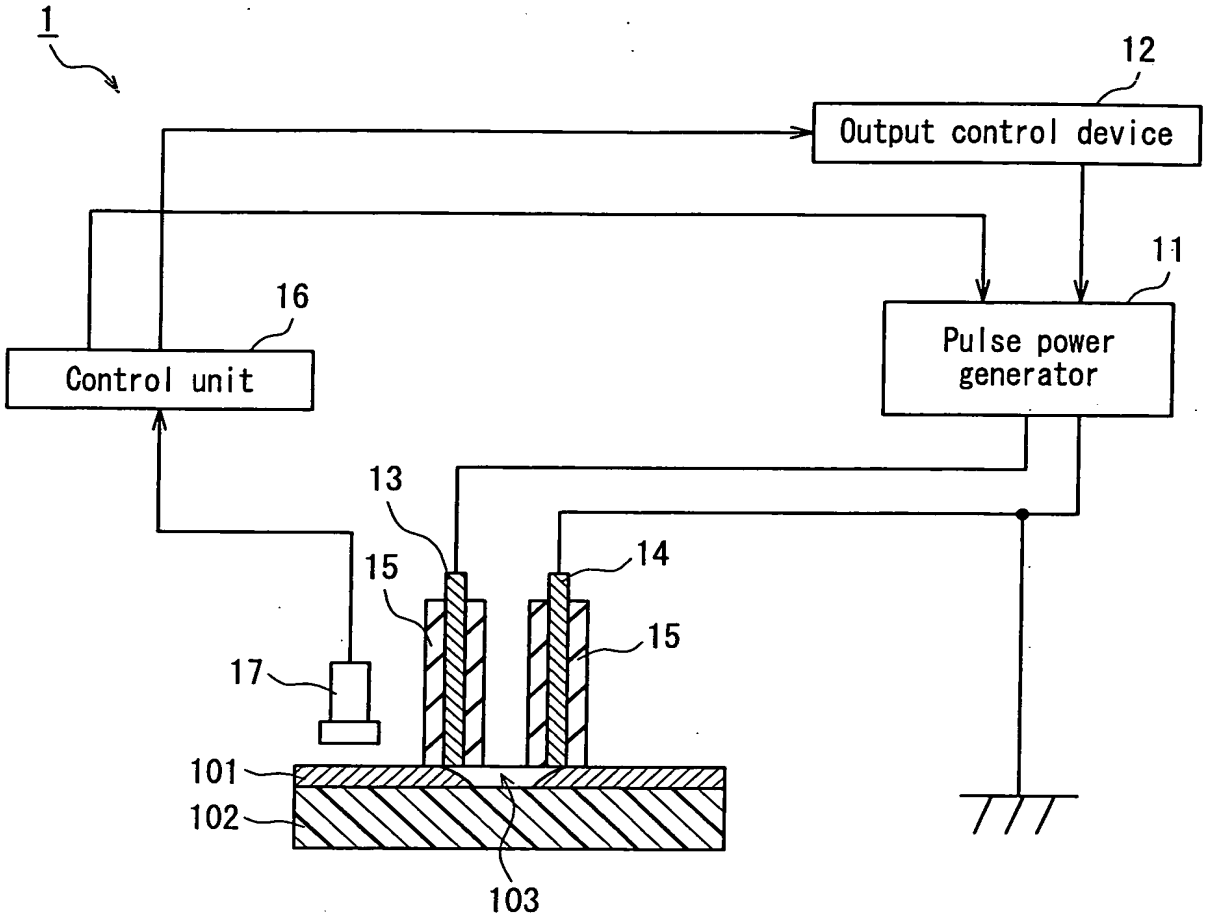

1
12
Output control device
11
16
Control unit
Pulse power generator
13
15
14
15
17
101
102
103

FIG. 2

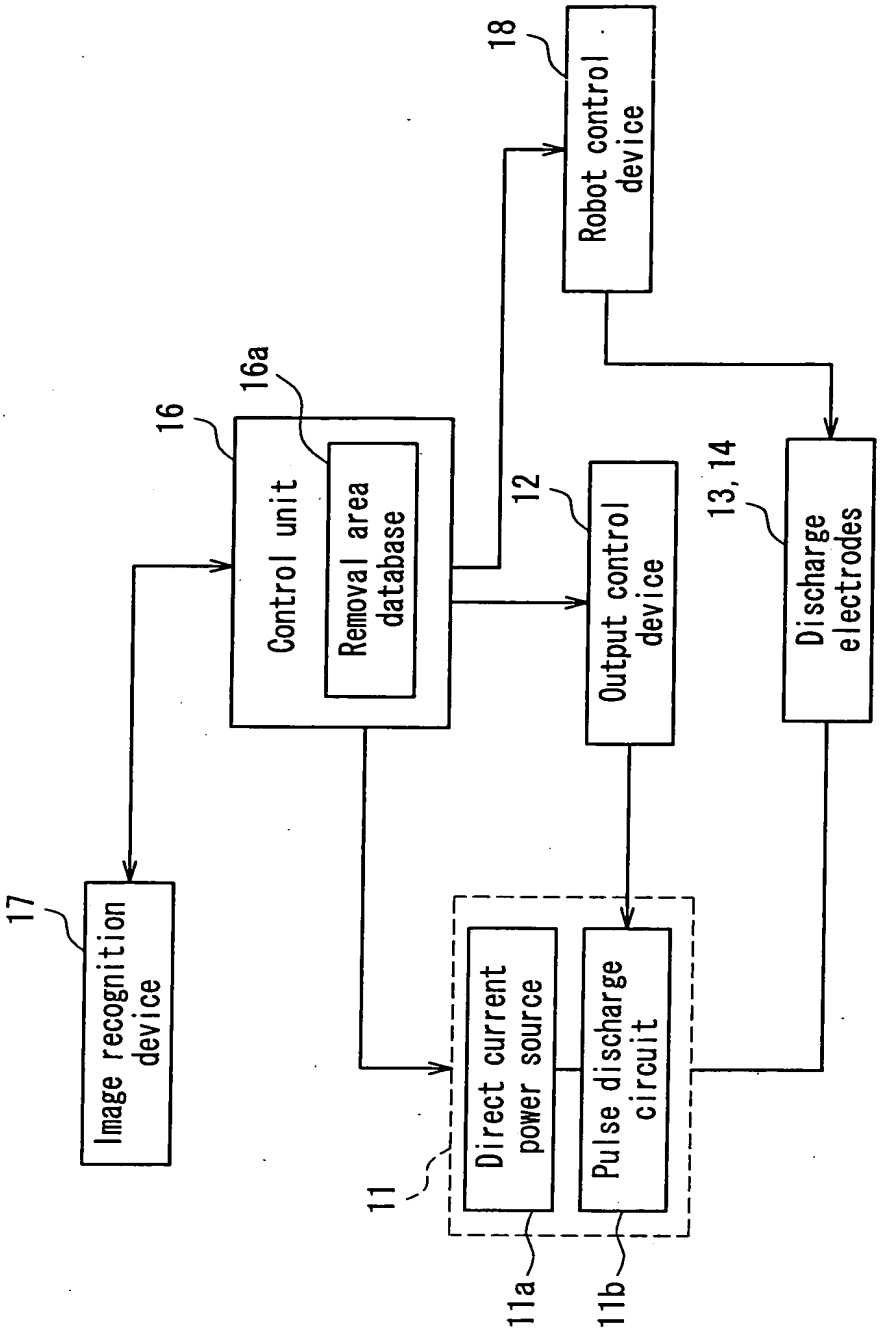

18
Robot control device
16a
16
Control unit
Removal area database
12
Output control device
13, 14
Discharge electrodes
17
Image recognition device
11
Direct current power source
Pulse discharge circuit
11a
11b

FIG. 3

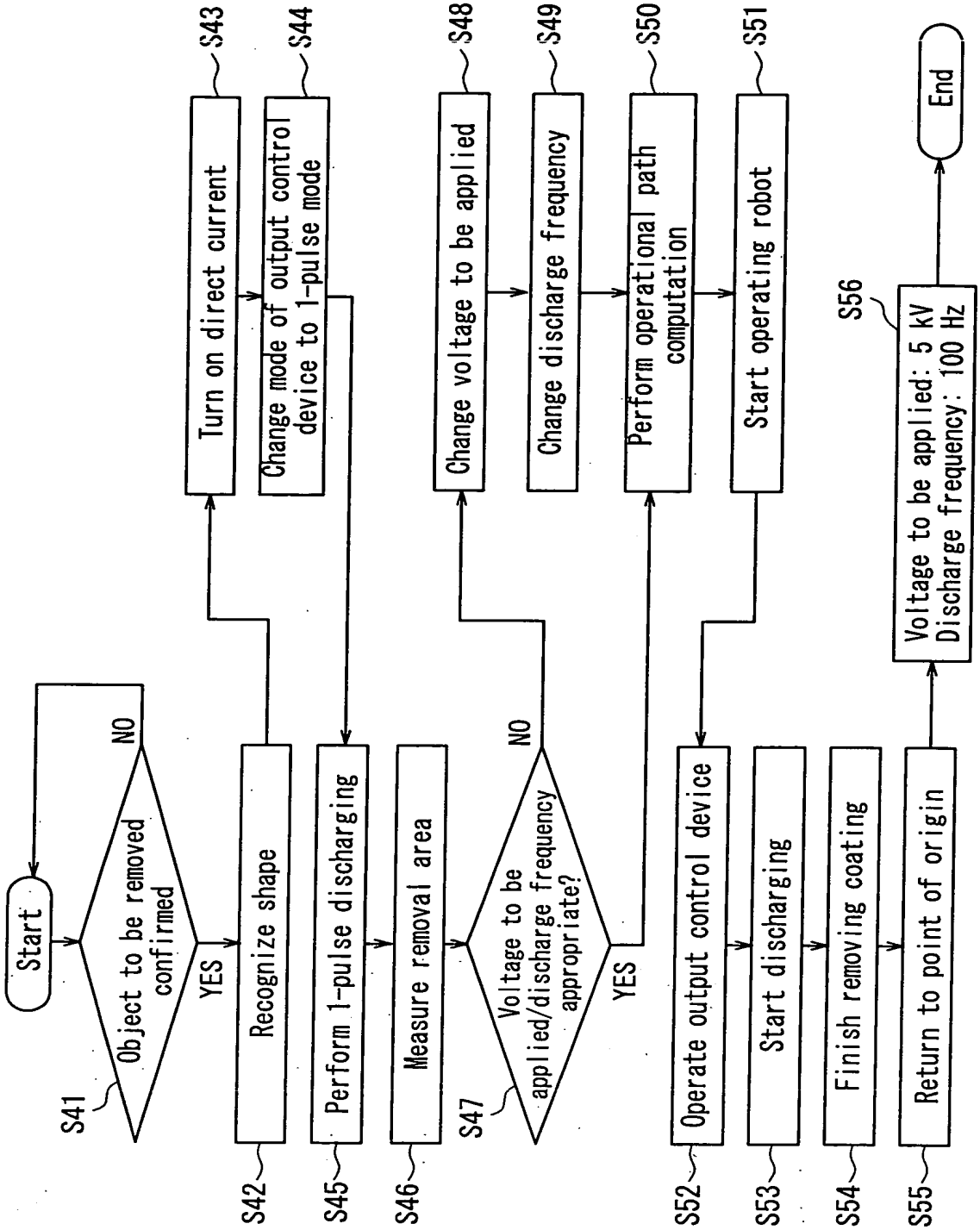

Start
Object to be removed confirmed
NO
YES
S41
Recognize shape
S42
Turn on direct current
S43
Change mode of output control device to 1-pulse mode
S44
Perform 1-pulse discharging
S45
Measure removal area
S46
Voltage to be applied/discharge frequency appropriate?
NO
YES
S47
Change voltage to be applied
S48
Change discharge frequency
S49
Perform operational path computation
S50
Start operating robot
S51
Operate output control device
S52
Start discharging
S53
Finish removing coating
S54
Return to point of origin
S55
Voltage to be applied: 5 kV
Discharge frequency: 100 Hz
S56
End

FIG. 4

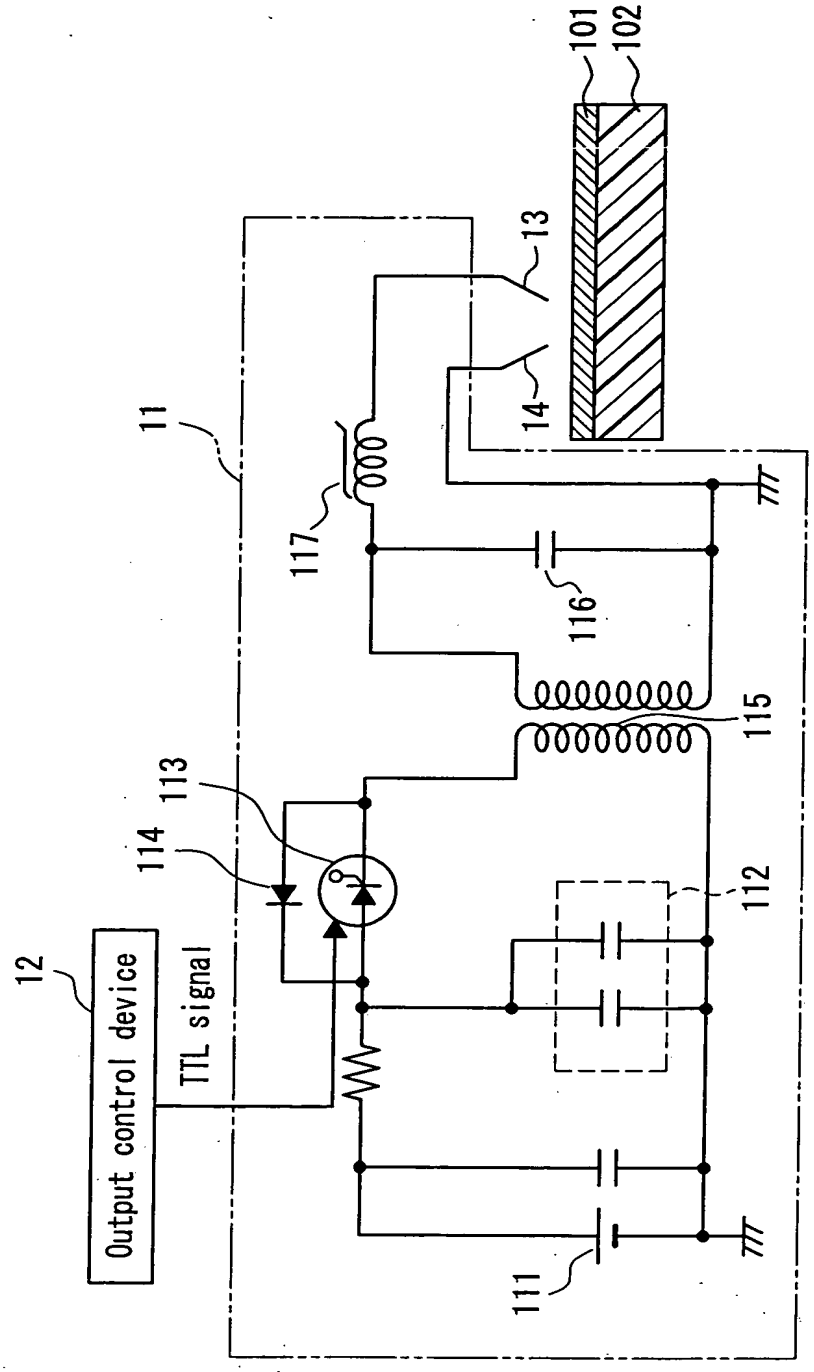

101
102
13
14
11
117
116
115
113
114
112
12
Output control device
TTL signal
111

FIG. 5

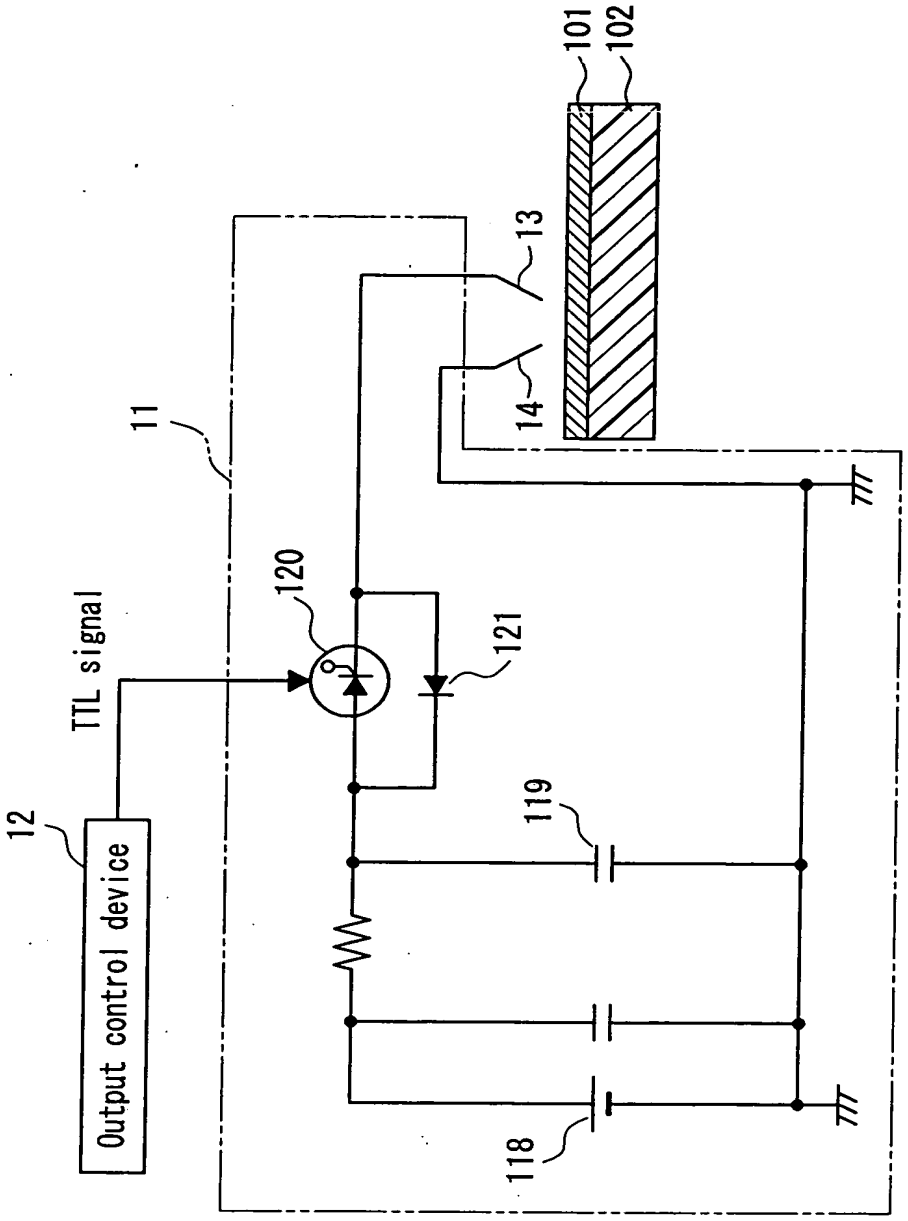

101
102
13
14
11
120
121
TTL signal
12
Output control device
119
118

FIG. 6

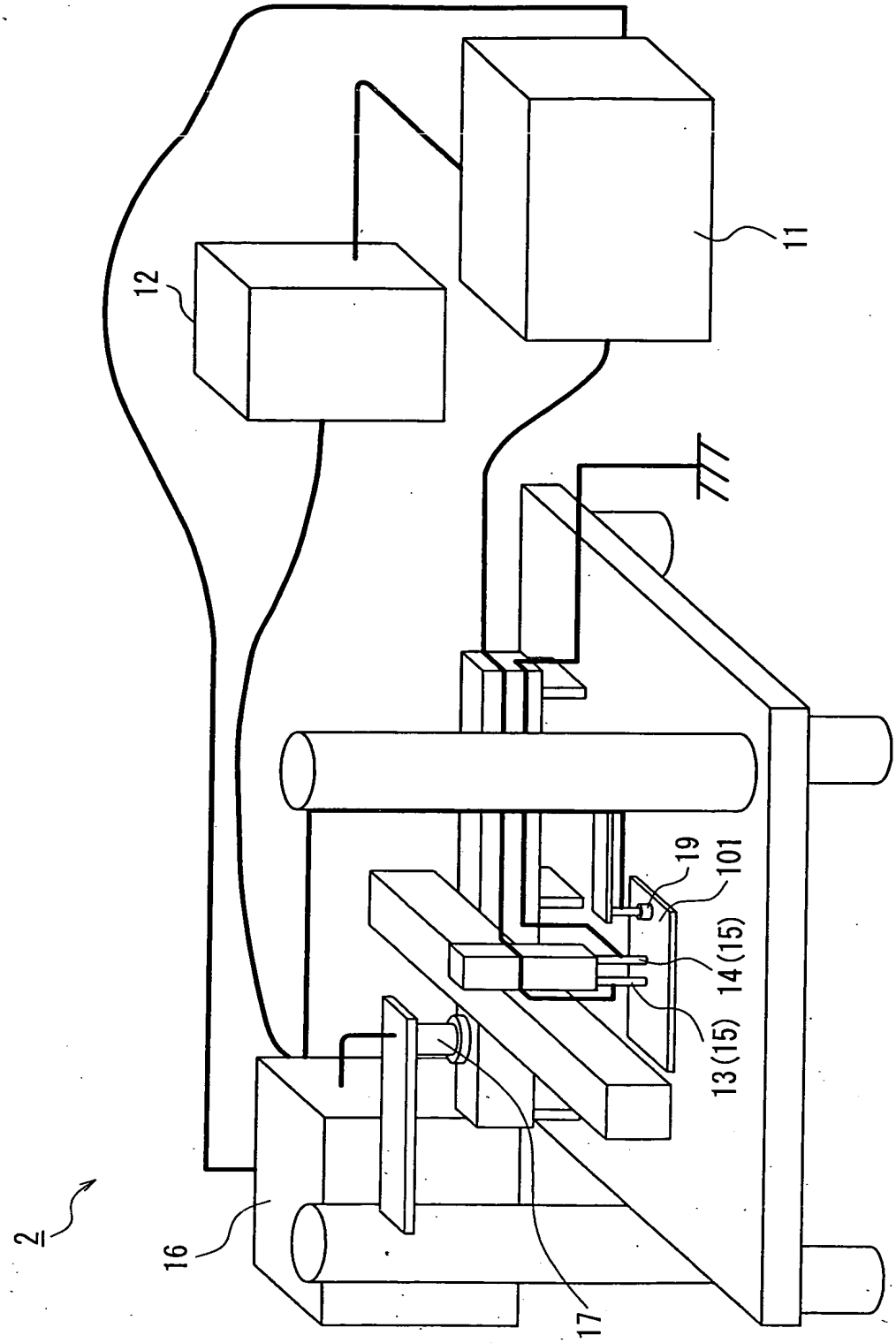


FIG. 7

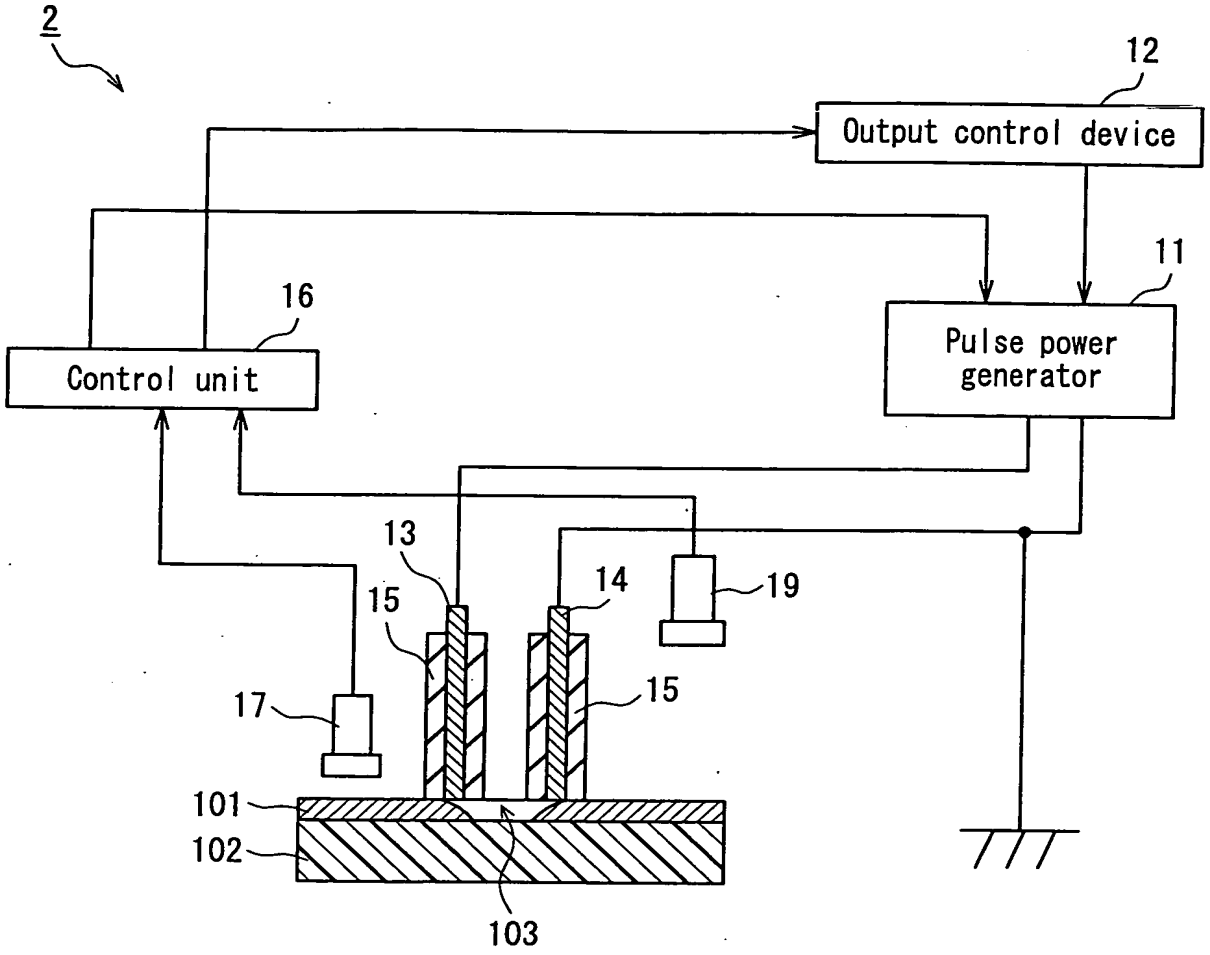

2
12
Output control device
11
16
Control unit
Pulse power generator
13
14
19
15
15
17
101
102
103

FIG. 8

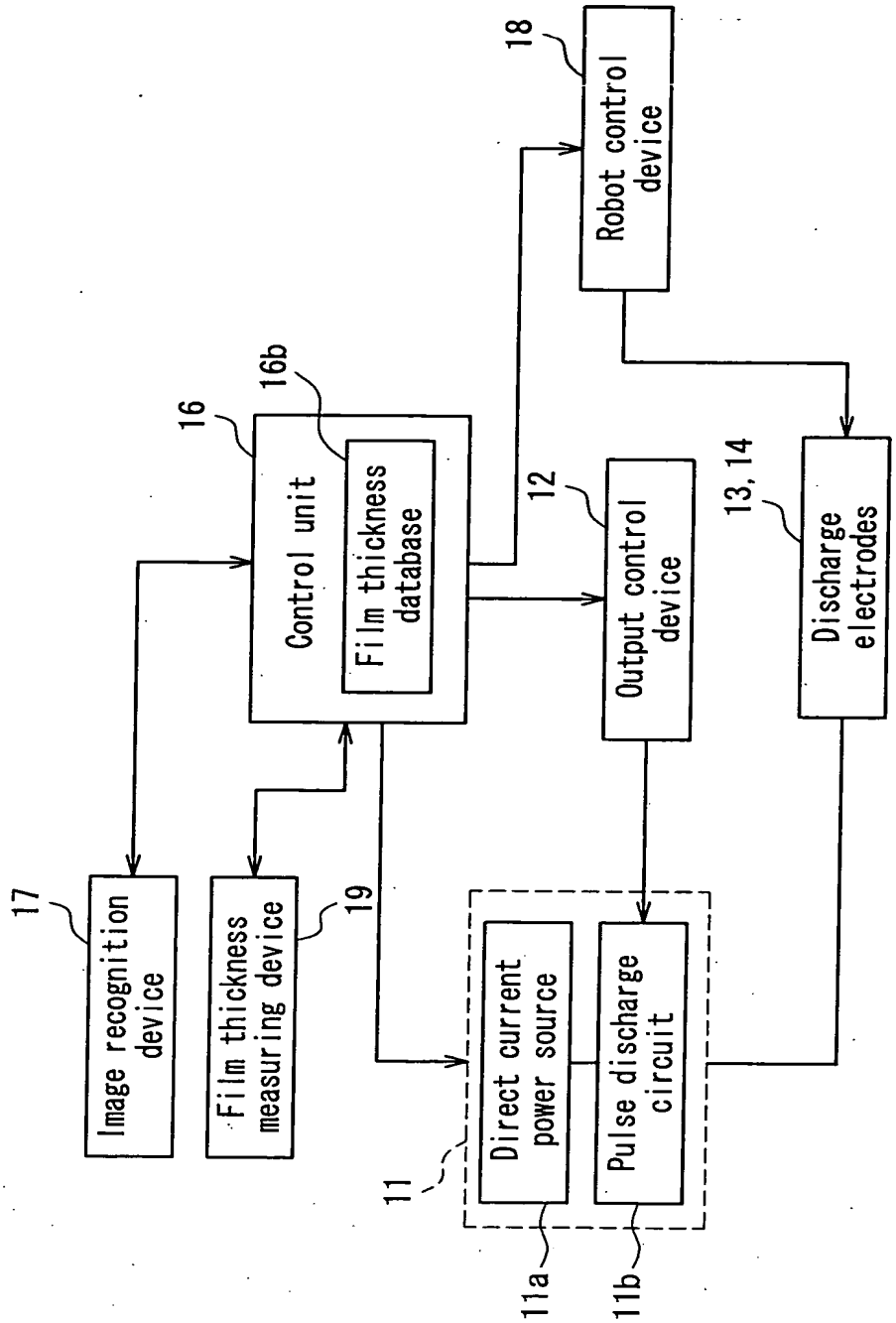

18
Robot control device
16b
16
Control unit
Film thickness database
12
Output control device
13, 14
Discharge electrodes
17
Image recognition device
Film thickness measuring device
19
11
Direct current power source
Pulse discharge circuit
11a
11b

FIG. 9

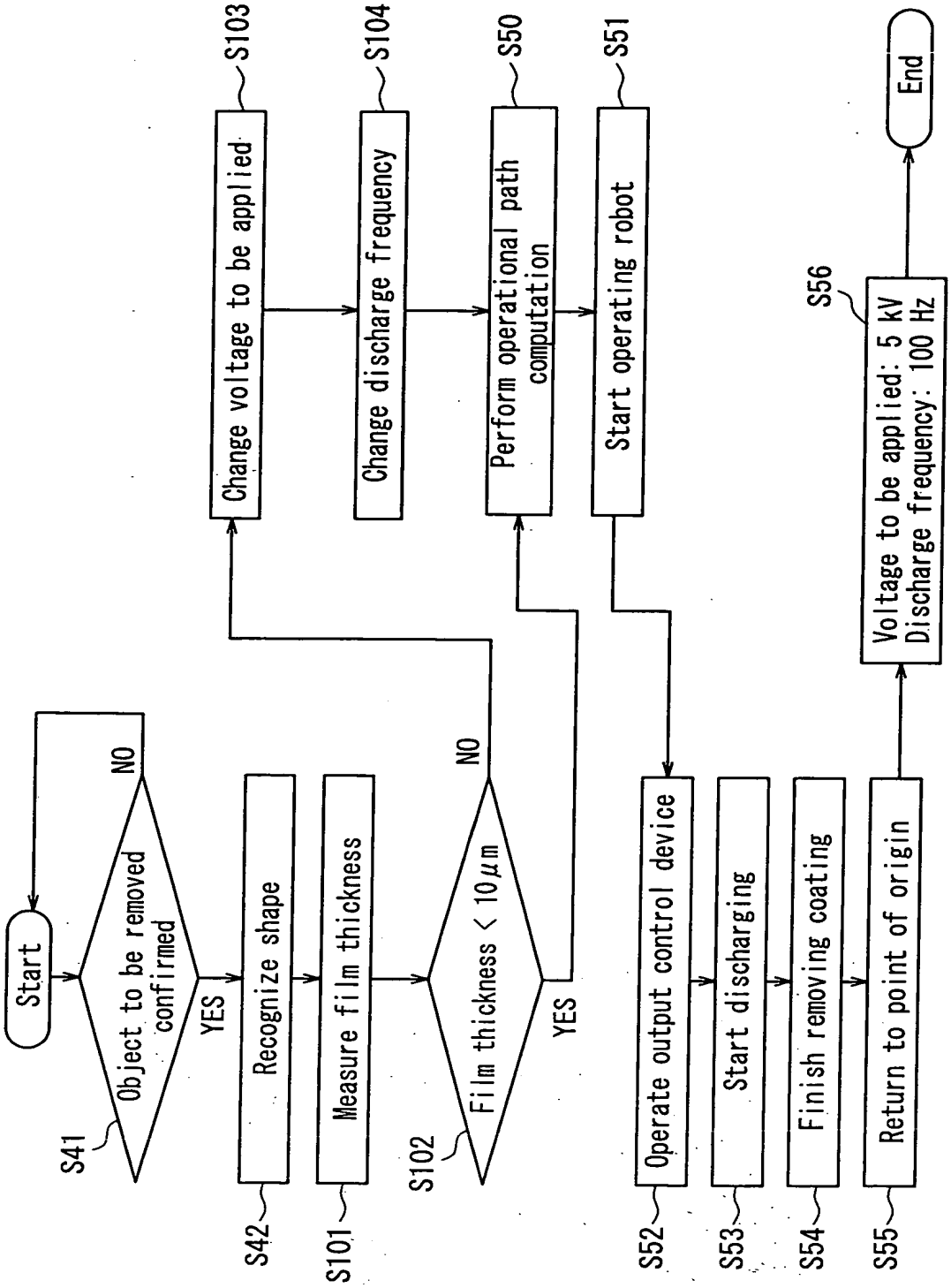

Start
Object to be removed confirmed
NO
YES
S41
Recognize shape
S42
Measure film thickness
S101
Film thickness < 10μm
NO
YES
S102
Change voltage to be applied
S103
Change discharge frequency
S104
Perform operational path computation
S50
Start operating robot
S51
Operate output control device
S52
Start discharging
S53
Finish removing coating
S54
Return to point of origin
S55
Voltage to be applied: 5 kV
Discharge frequency: 100 Hz
S56
End

FIG. 10

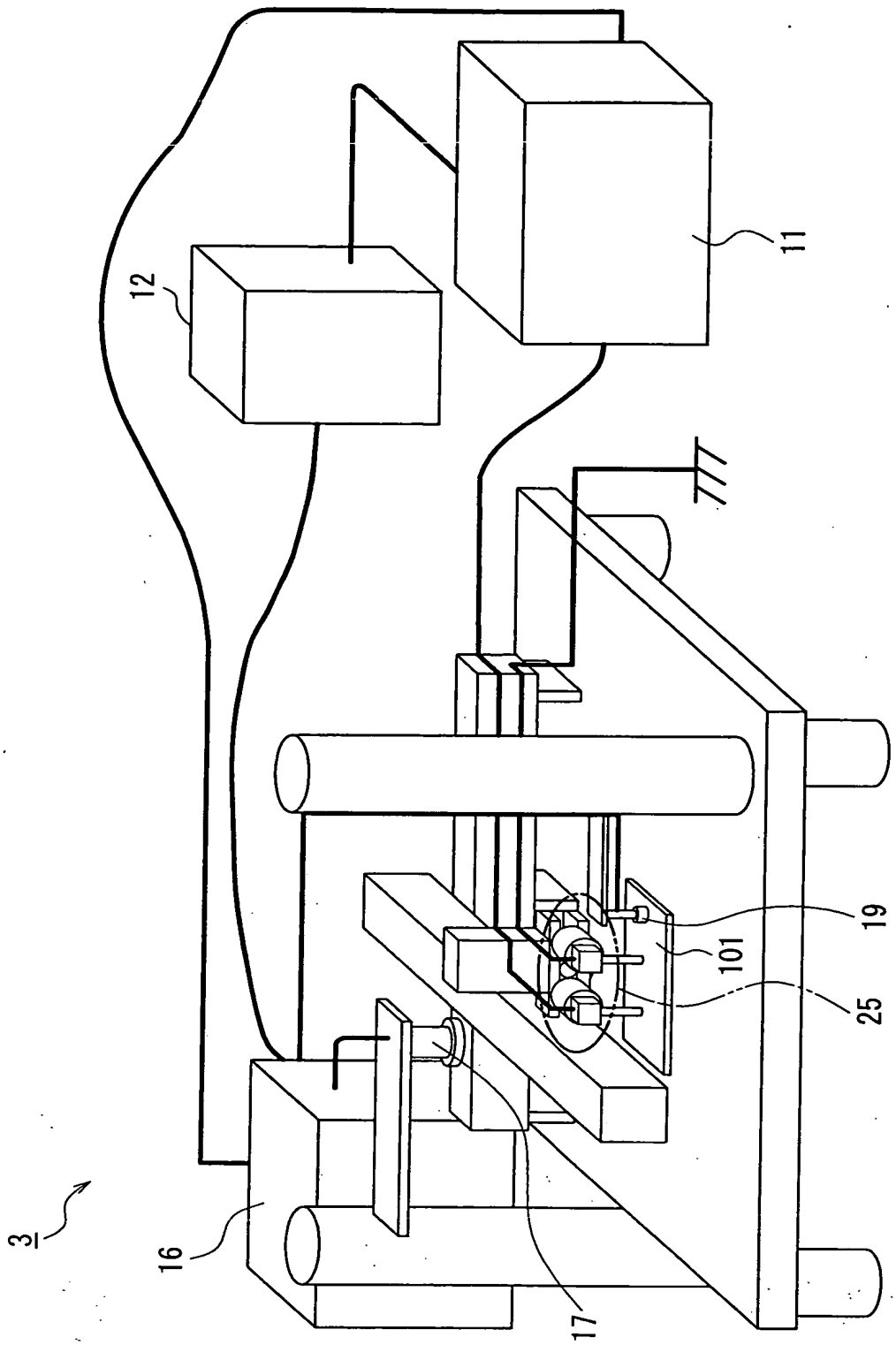


FIG. 11

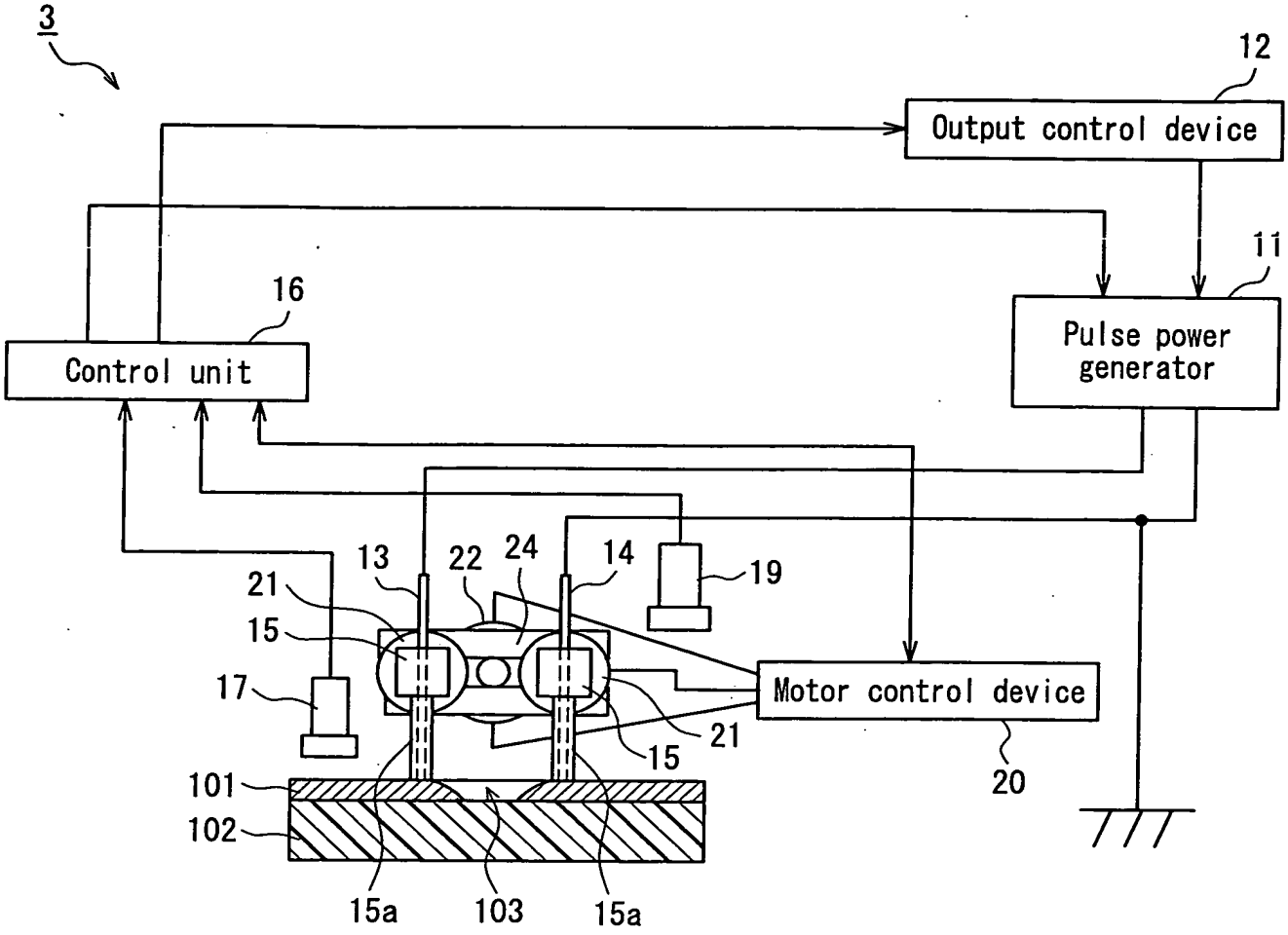

3
12
Output control device
11
Pulse power generator
16
Control unit
13
22
24
14
19
21
15
17
Motor control device
21
15
20
101
102
15a
103
15a

FIG. 12

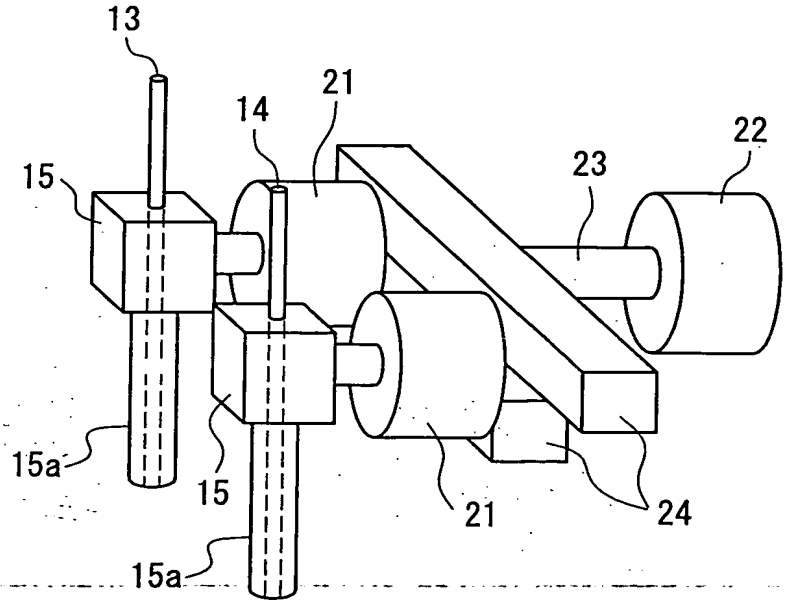

13
21
14
22
23
15
15a
15
21
24
15a

FIG. 13

FIG. 14A

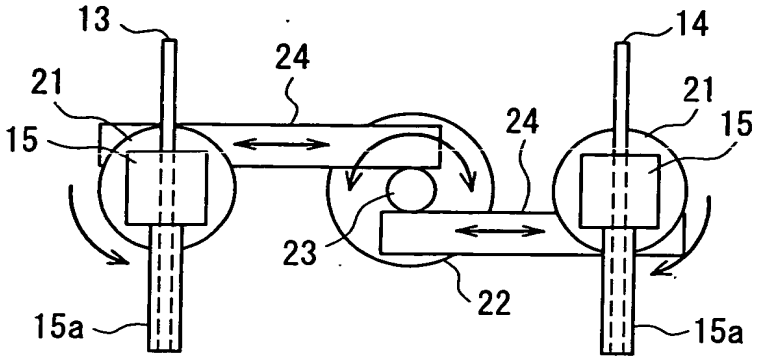


FIG. 14B

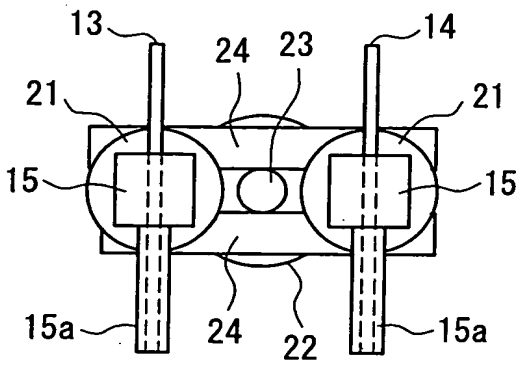


FIG. 14C

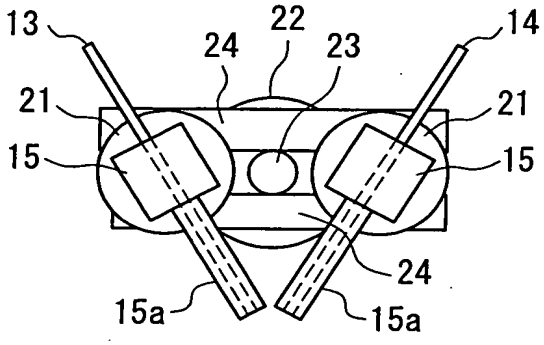
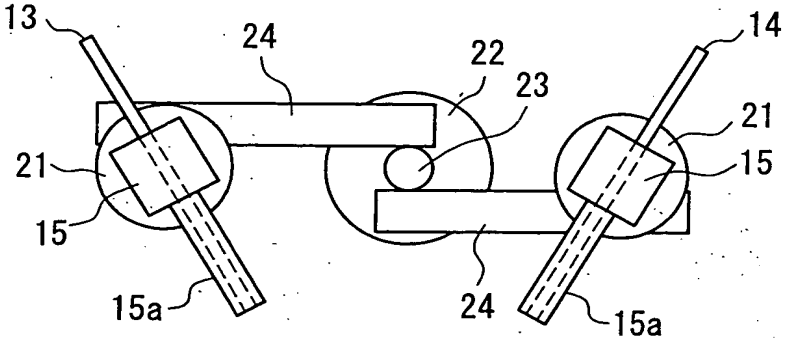


FIG. 14D



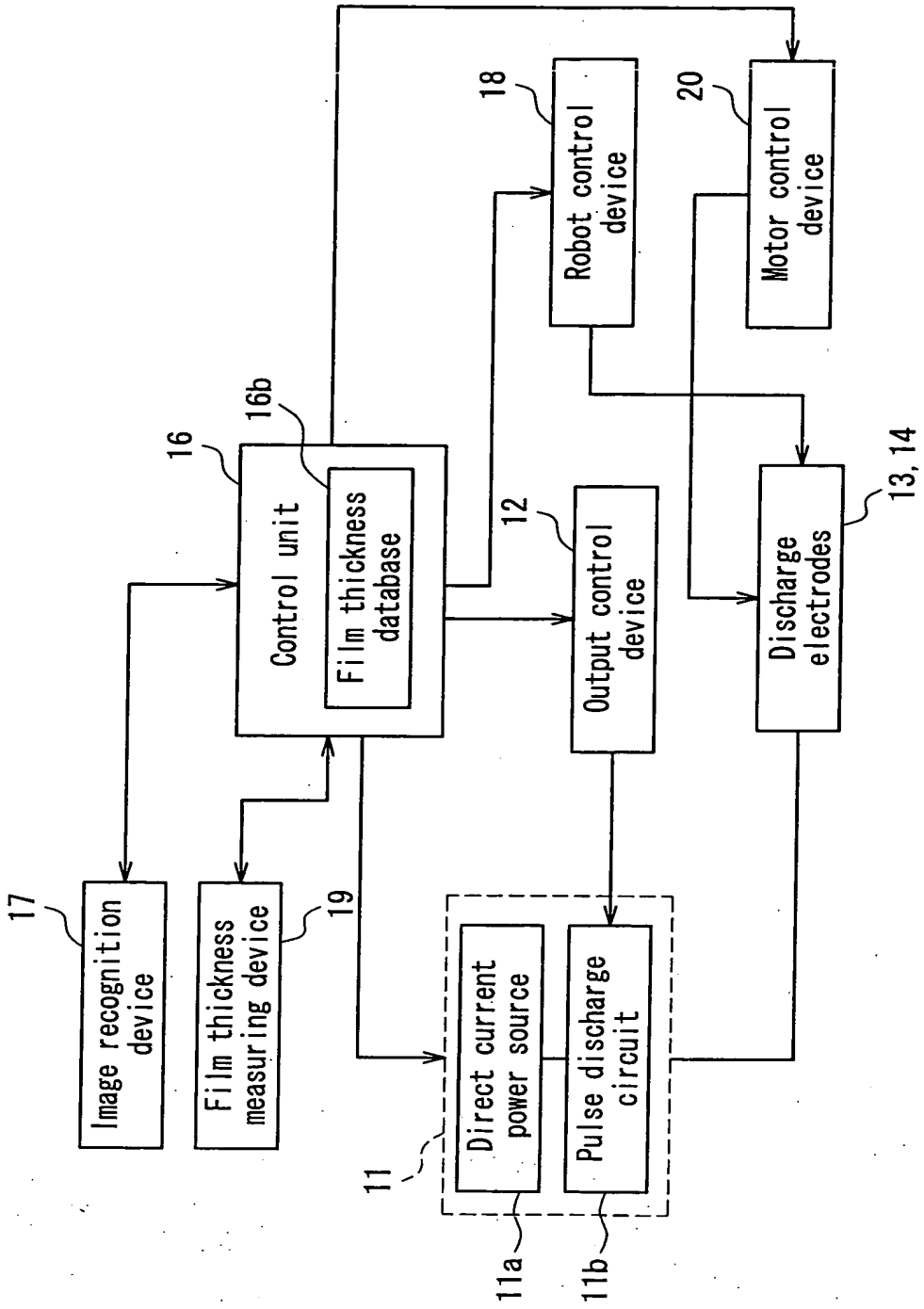

Robot control device
18
Motor control device
20
16b
16
Control unit
Film thickness database
12
Output control device
Discharge electrodes
13, 14
17
Image recognition device
Film thickness measuring device
19
11
Direct current power source
Pulse discharge circuit
11a
11b

FIG. 15

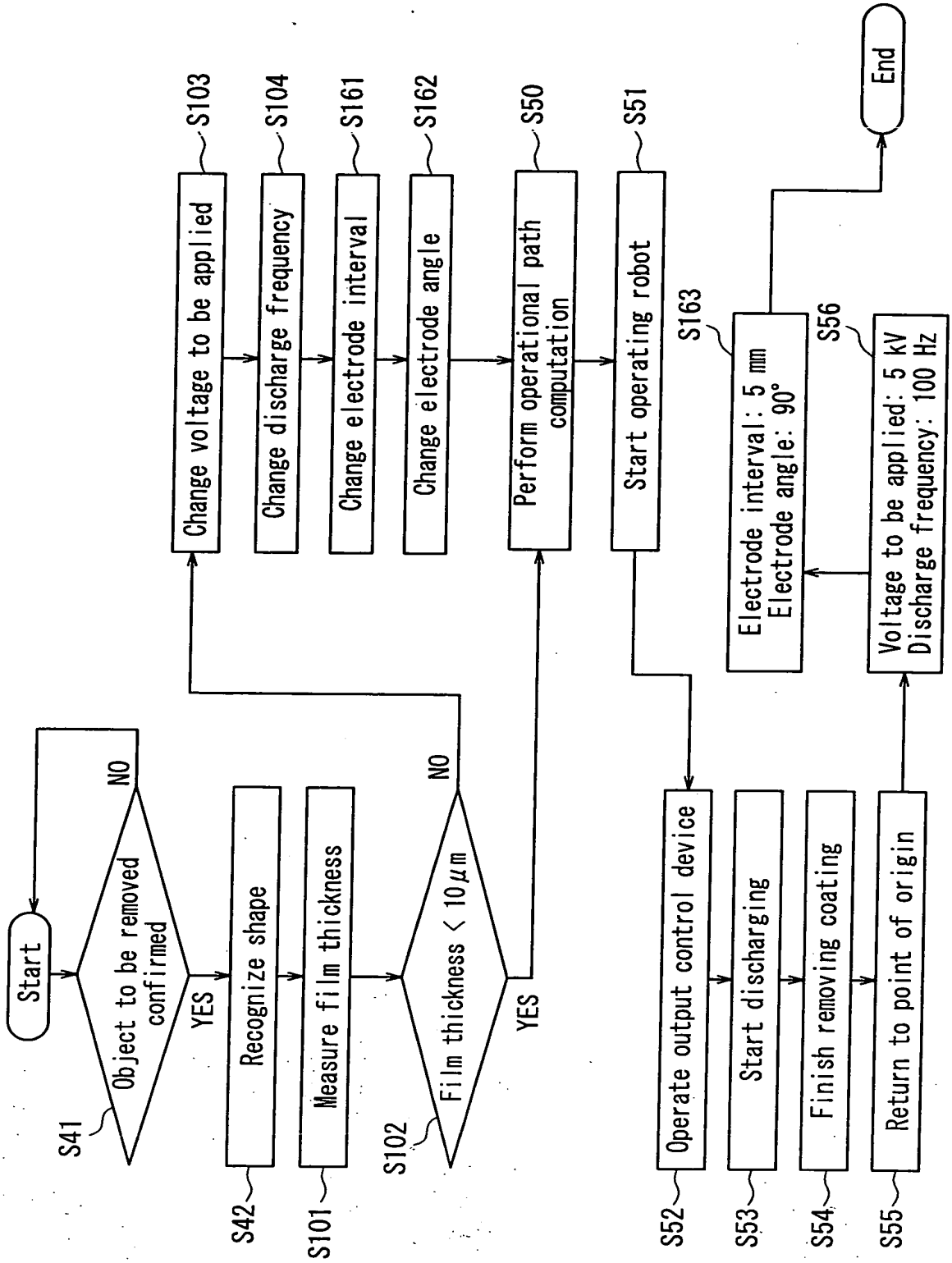

Start
Object to be removed confirmed
S41
NO
YES
Recognize shape
S42
Measure film thickness
S101
Film thickness < 10 μm
S102
NO
YES
Change voltage to be applied
S103
Change discharge frequency
S104
Change electrode interval
S161
Change electrode angle
S162
Perform operational path computation
S50
Start operating robot
S51
Operate output control device
S52
Start discharging
S53
Finish removing coating
S54
Return to point of origin
S55
Voltage to be applied: 5 kV
Discharge frequency: 100 Hz
S56
Electrode interval: 5 mm
Electrode angle: 90°
S163
End

FIG. 16

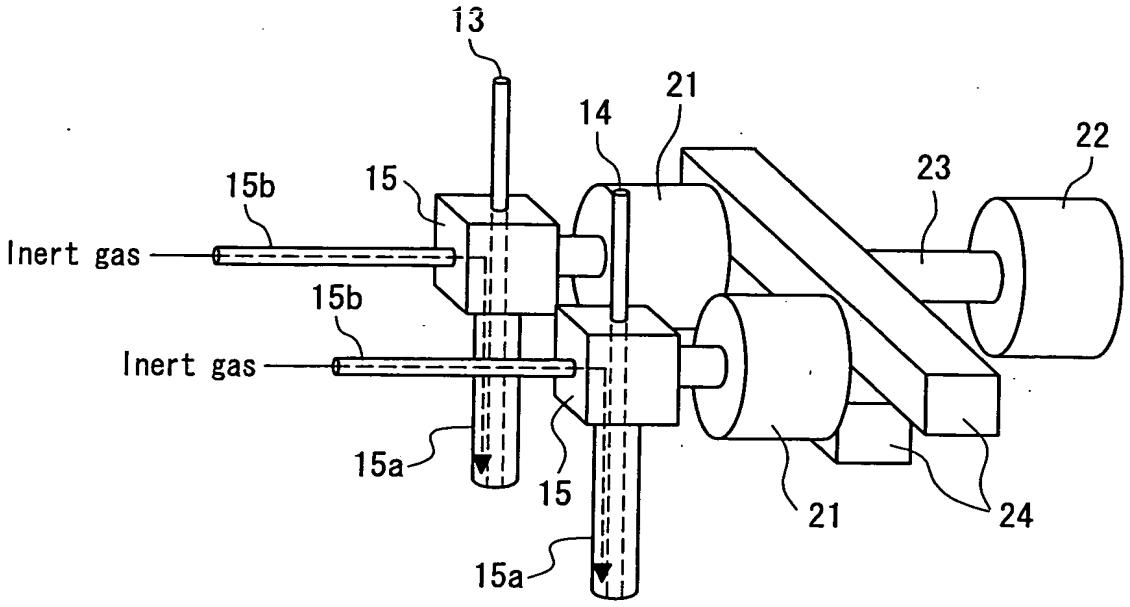


FIG. 17

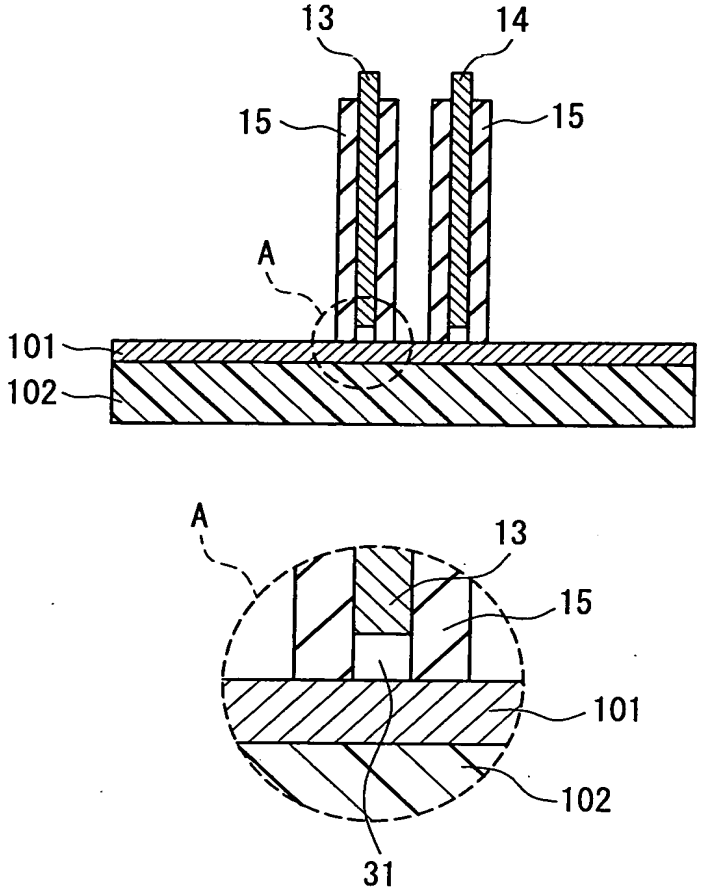


FIG. 18

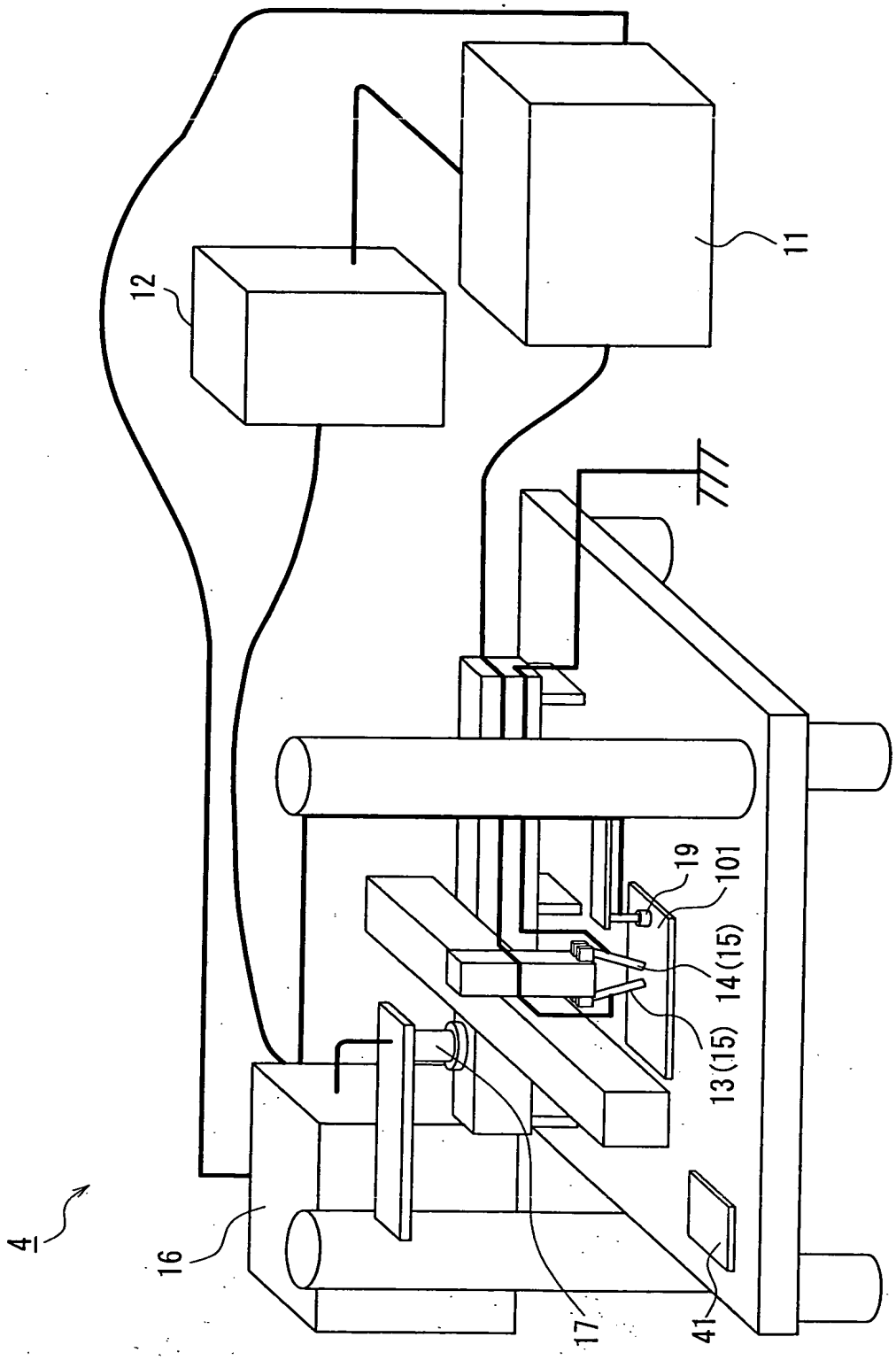


FIG. 19

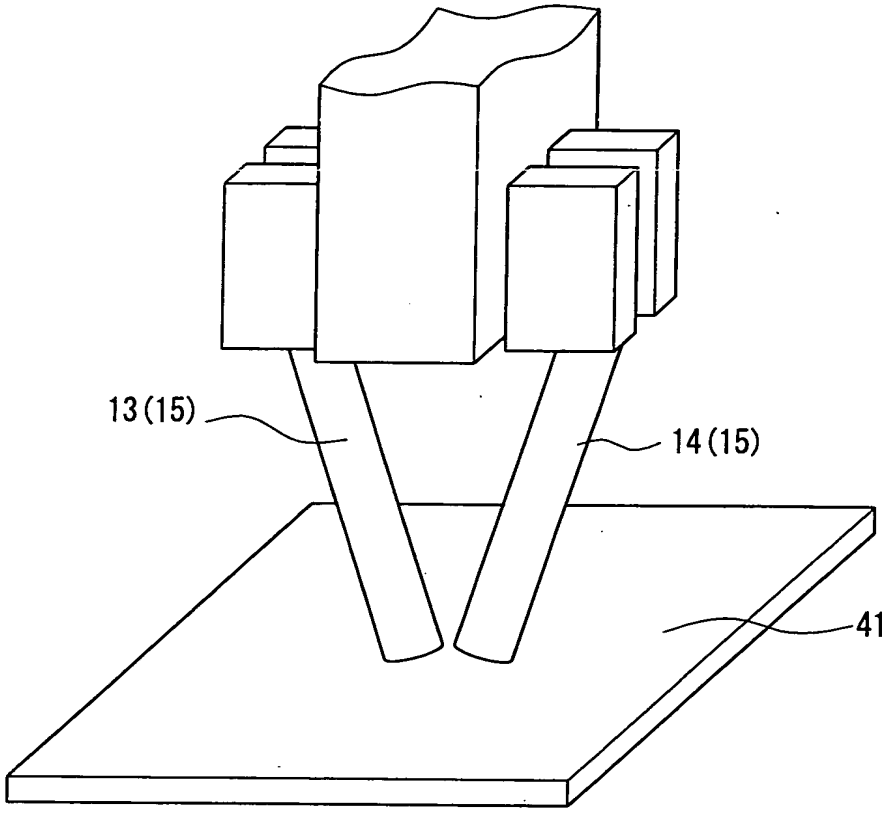


FIG. 20A

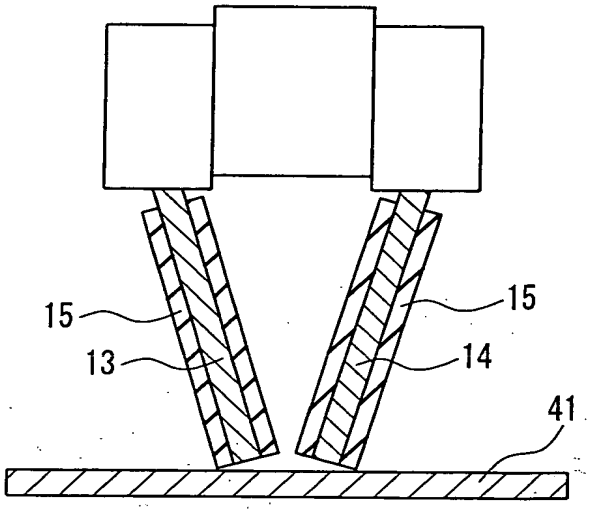


FIG. 20B

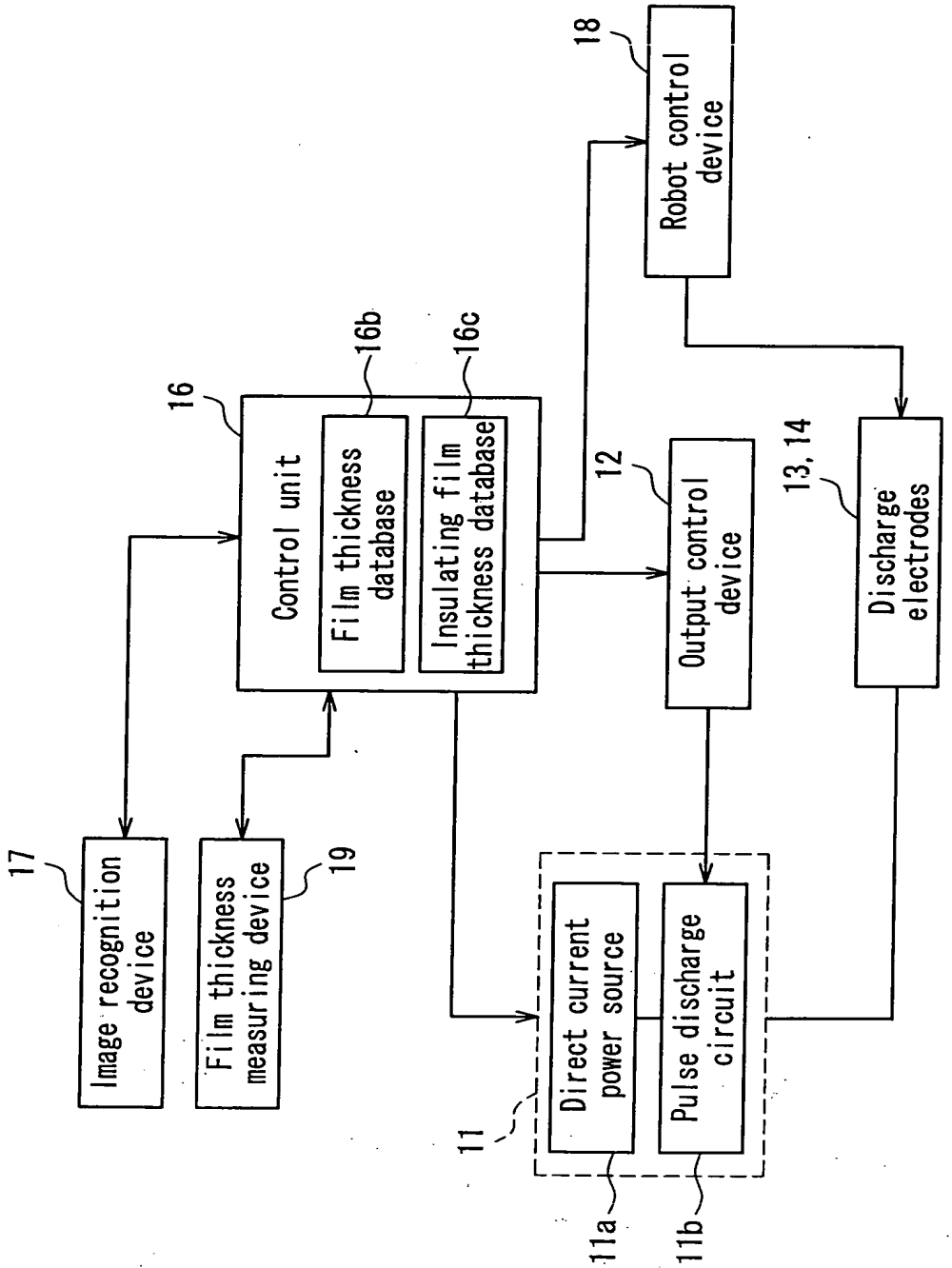

18
Robot control device
16b
16c
16
Control unit
Film thickness database
Insulating film thickness database
12
Output control device
13, 14
Discharge electrodes
17
Image recognition device
Film thickness measuring device
19
11
Direct current power source
Pulse discharge circuit
11a
11b

FIG. 21

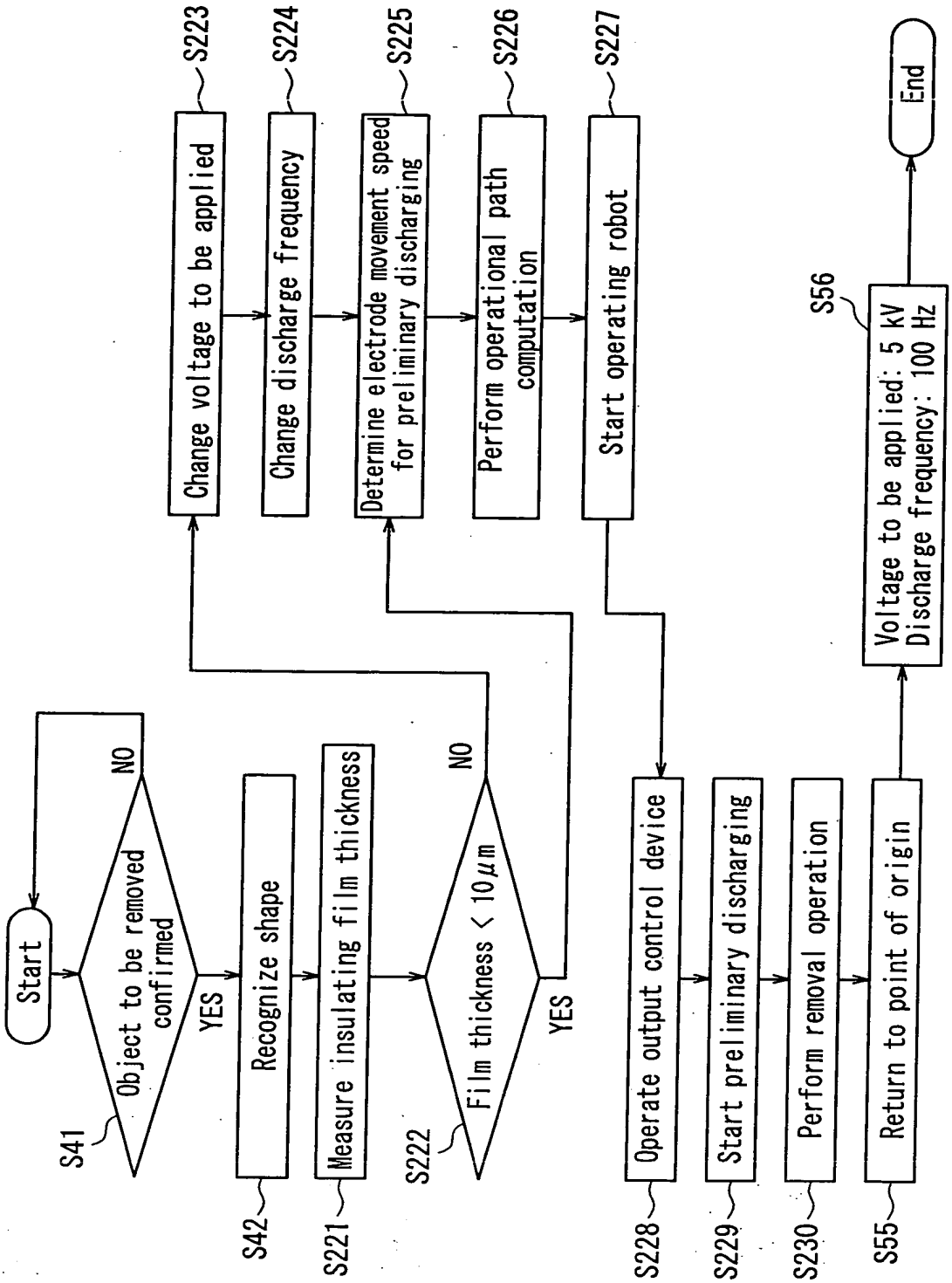

Start
Object to be removed confirmed
S41
NO
YES
Recognize shape
S42
Measure insulating film thickness
S221
Film thickness < 10 μm
S222
NO
YES
Change voltage to be applied
S223
Change discharge frequency
S224
Determine electrode movement speed for preliminary discharging
S225
Perform operational path computation
S226
Start operating robot
S227
Operate output control device
S228
Start preliminary discharging
S229
Perform removal operation
S230
Return to point of origin
S55
Voltage to be applied: 5 kV
Discharge frequency: 100 Hz
S56
End

FIG. 22

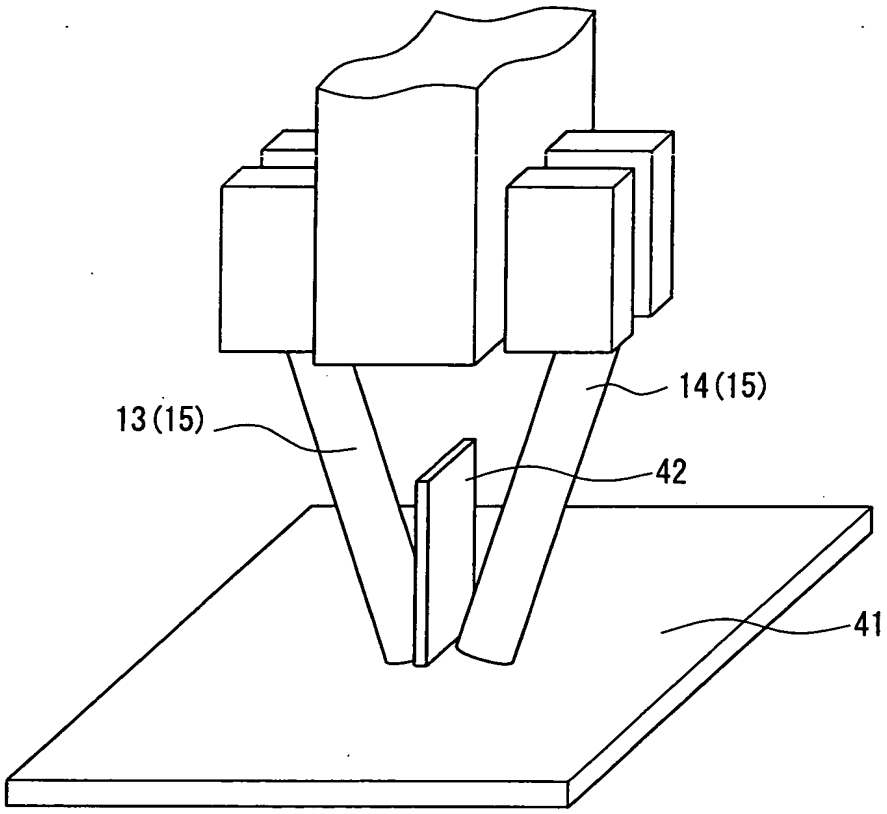


FIG. 23A

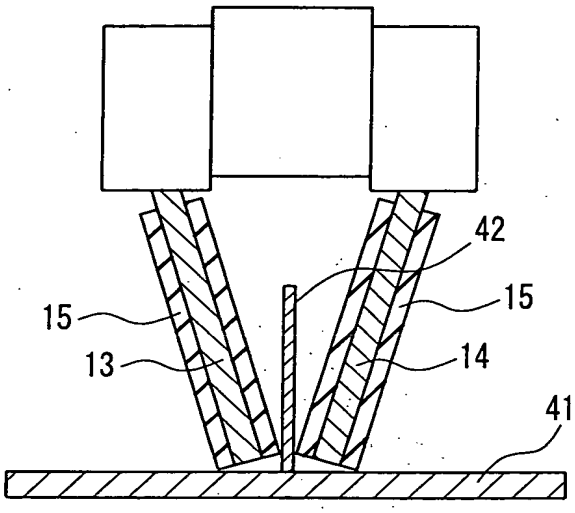


FIG. 23B

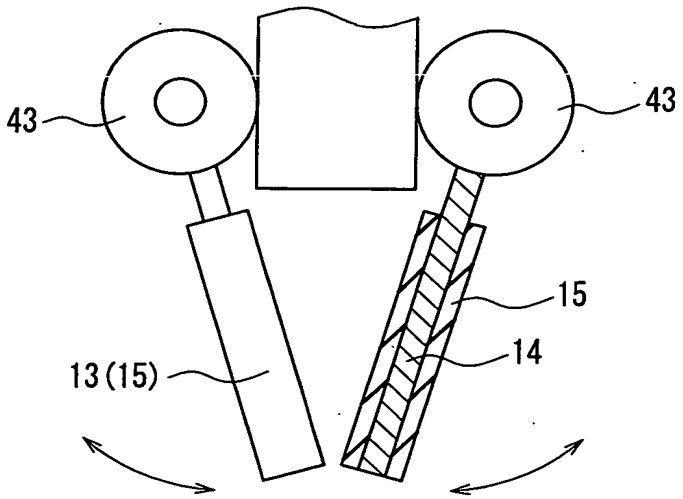


FIG. 24

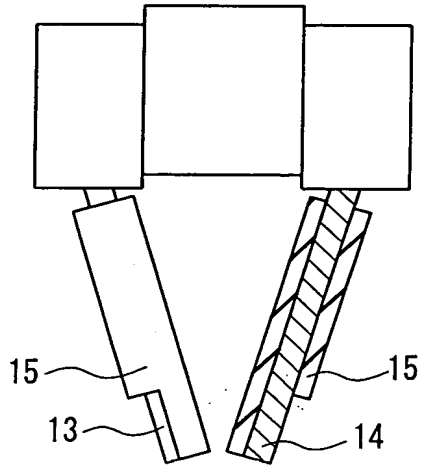


FIG. 25

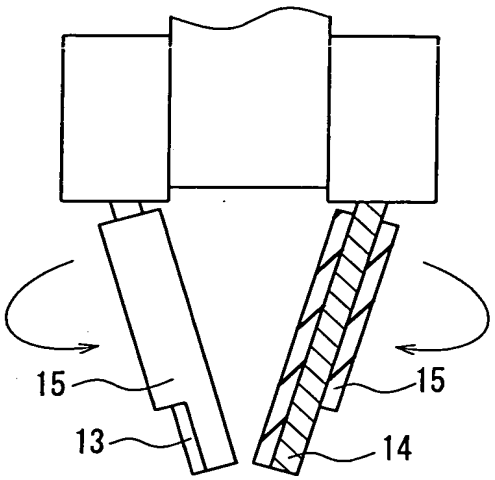


FIG. 26A

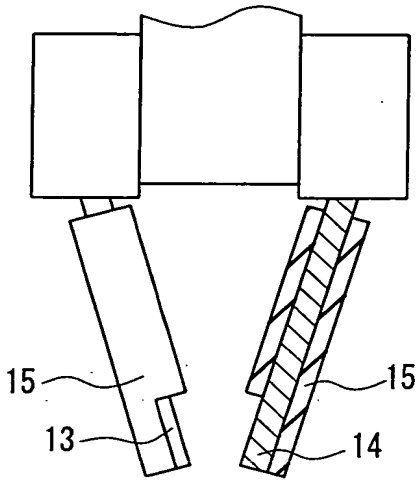


FIG. 26B

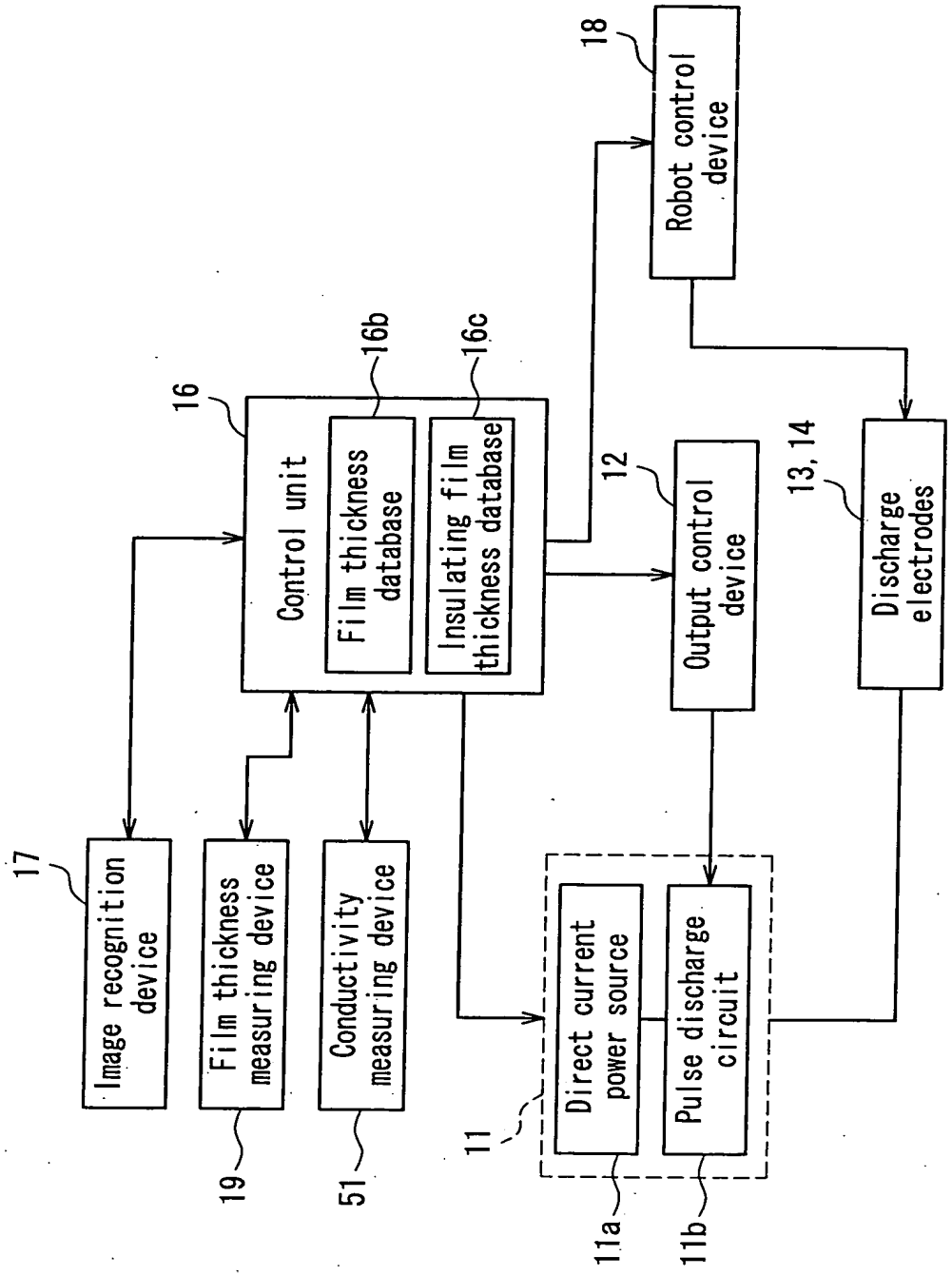

18
Robot control device
16b
16c
16
Control unit
Film thickness database
Insulating film thickness database
12
Output control device
13, 14
Discharge electrodes
17
Image recognition device
Film thickness measuring device
Conductivity measuring device
11
Direct current power source
Pulse discharge circuit
19
51
11a
11b

FIG. 27

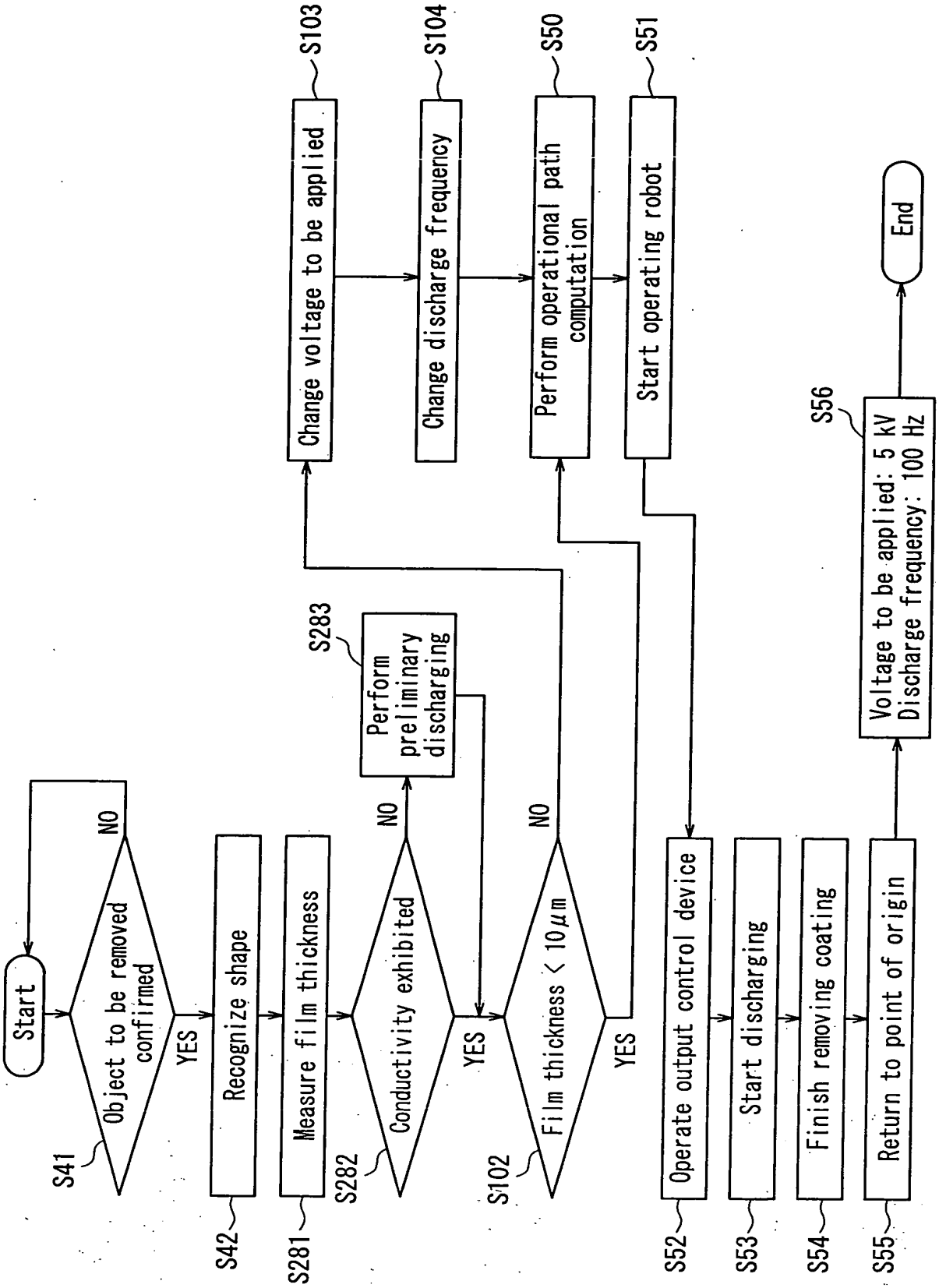

Start
Object to be removed confirmed
S41
NO
YES
Recognize shape
S42
Measure film thickness
S281
Conductivity exhibited
S282
NO
YES
Perform preliminary discharging
S283
Film thickness < 10μm
S102
NO
YES
Change voltage to be applied
S103
Change discharge frequency
S104
Perform operational path computation
S50
Start operating robot
S51
Operate output control device
S52
Start discharging
S53
Finish removing coating
S54
Return to point of origin
S55
Voltage to be applied: 5 kV
Discharge frequency: 100 Hz
S56
End

FIG. 28

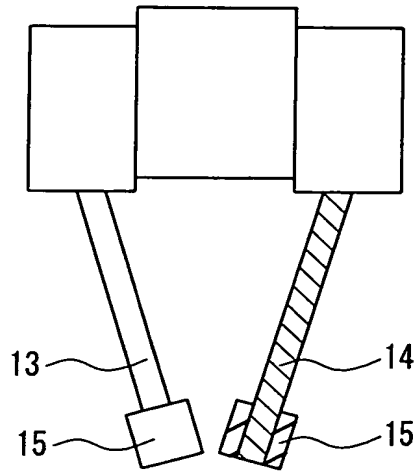


FIG. 29

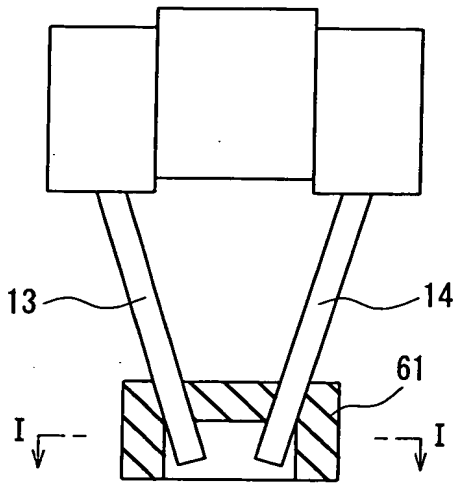


FIG. 30A

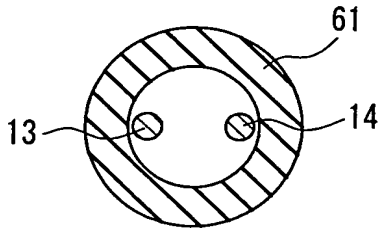


FIG. 30B

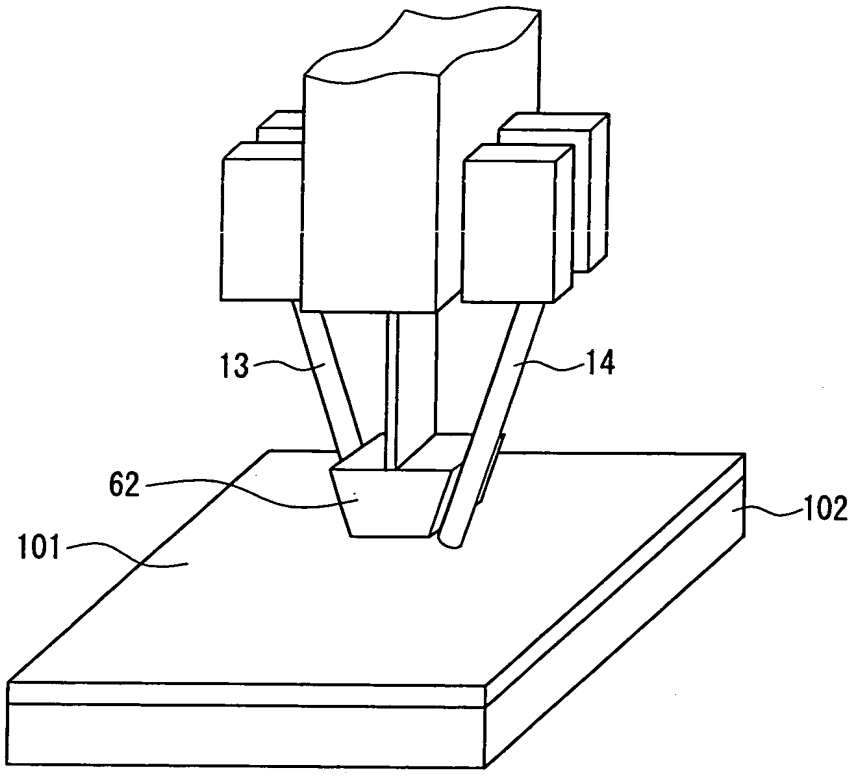


FIG. 31A

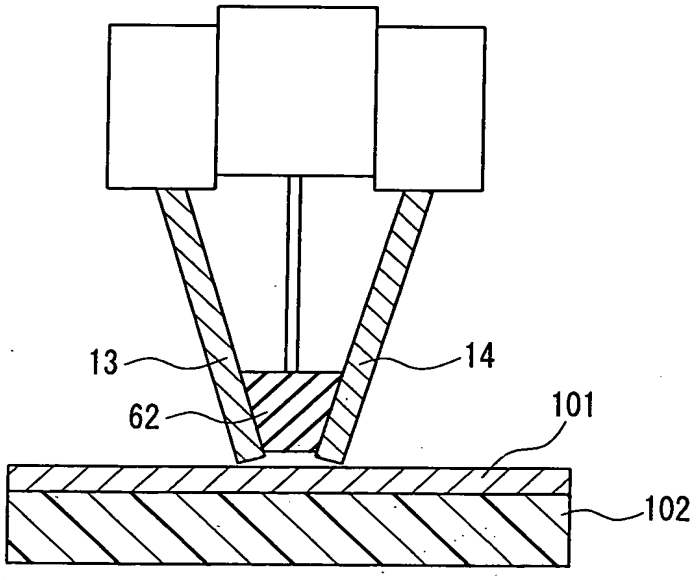


FIG. 31B

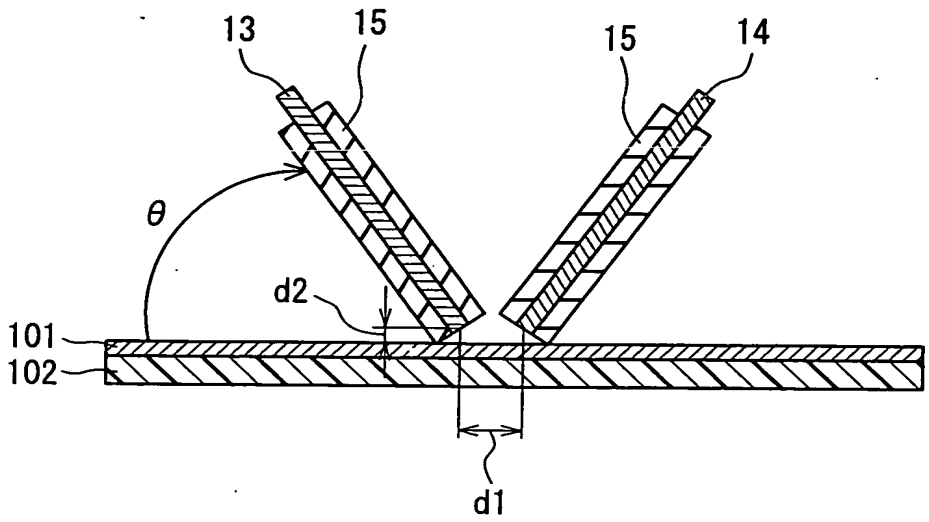

13
15
15
14
θ
d2
101
102
d1

FIG. 32

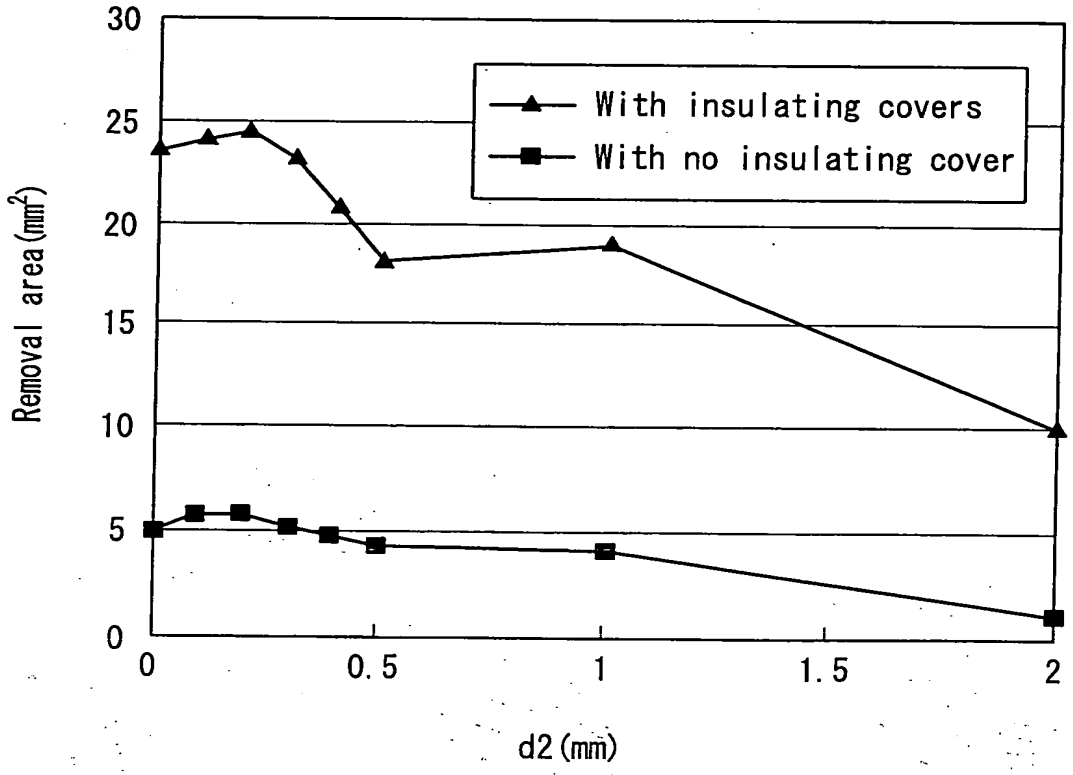

30
25
20
15
10
5
0
0
0.5
1
1.5
2
Removal area (mm²)
d2 (mm)
With insulating covers
With no insulating cover

FIG. 33

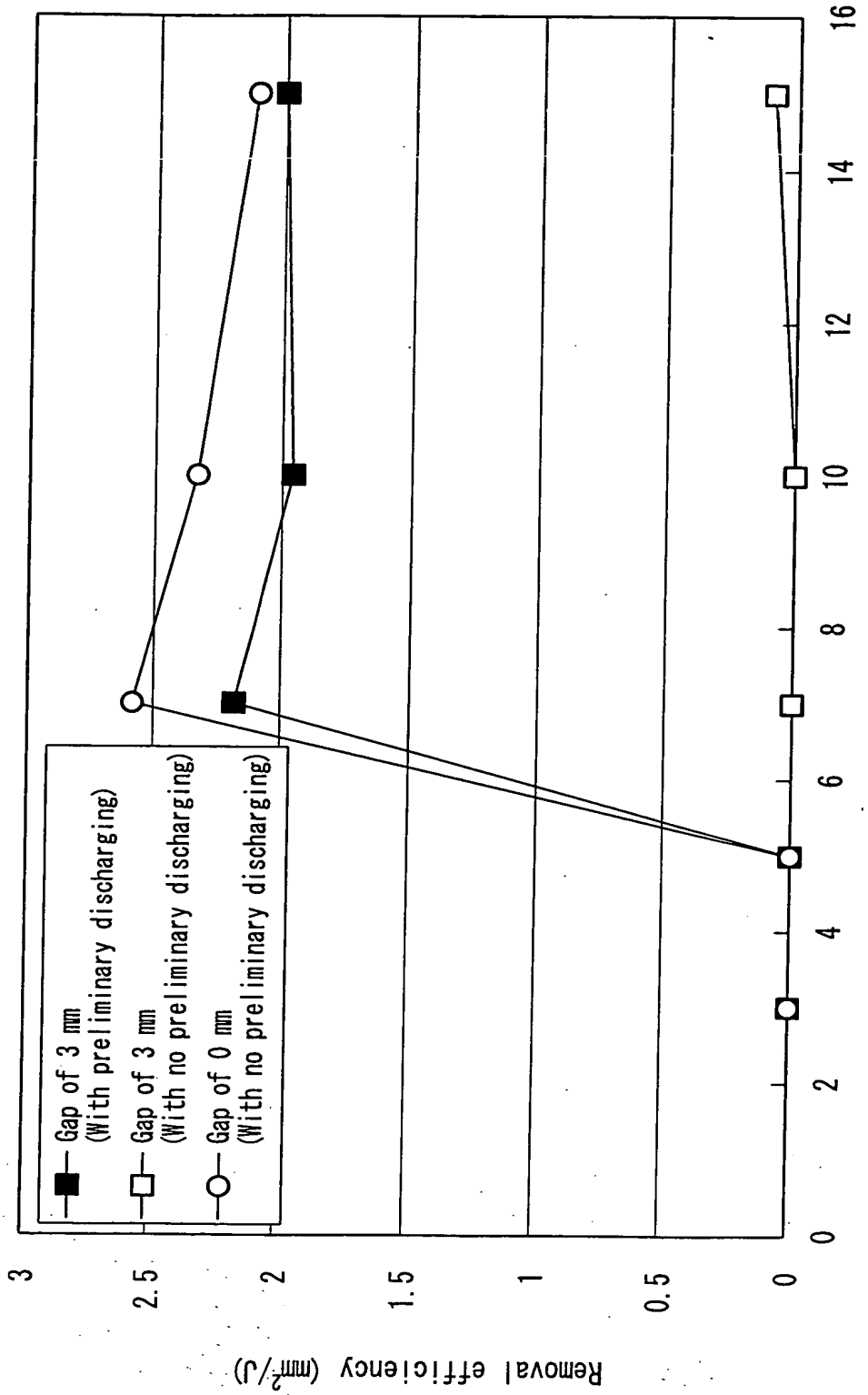

Removal efficiency (mm²/J)
3
2.5
2
1.5
1
0.5
0
0
2
4
6
8
10
12
14
16
Applied voltage (kV)
Gap of 3 mm (With preliminary discharging)
Gap of 3 mm (With no preliminary discharging)
Gap of 0 mm (With no preliminary discharging)

FIG. 34

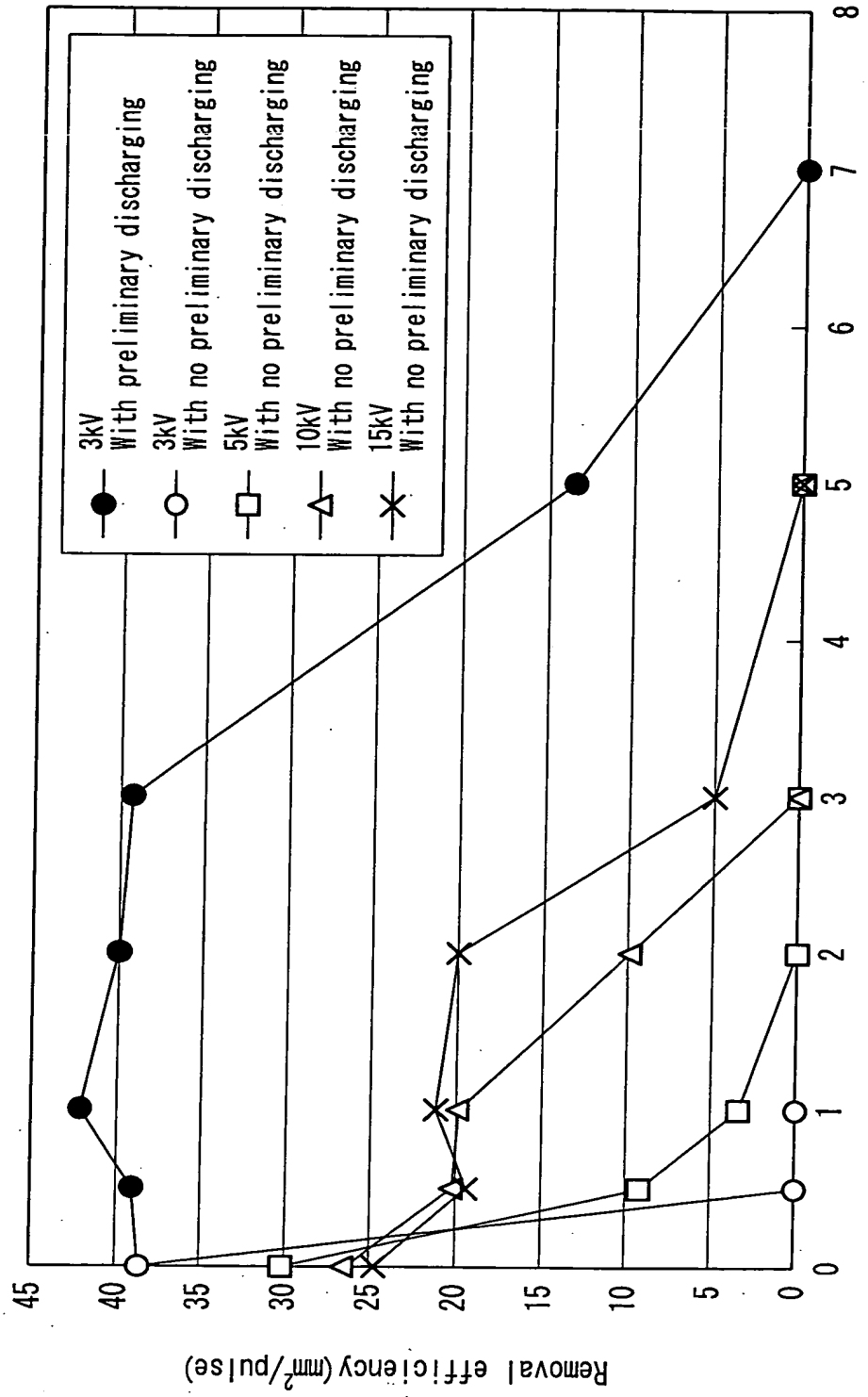

3kV With preliminary discharging
3kV With no preliminary discharging
5kV With no preliminary discharging
10kV With no preliminary discharging
15kV With no preliminary discharging
Removal efficiency (mm²/pulse)
Gap (mm)
0
5
10
15
20
25
30
35
40
45
0
1
2
3
4
5
6
7
8

FIG. 35

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